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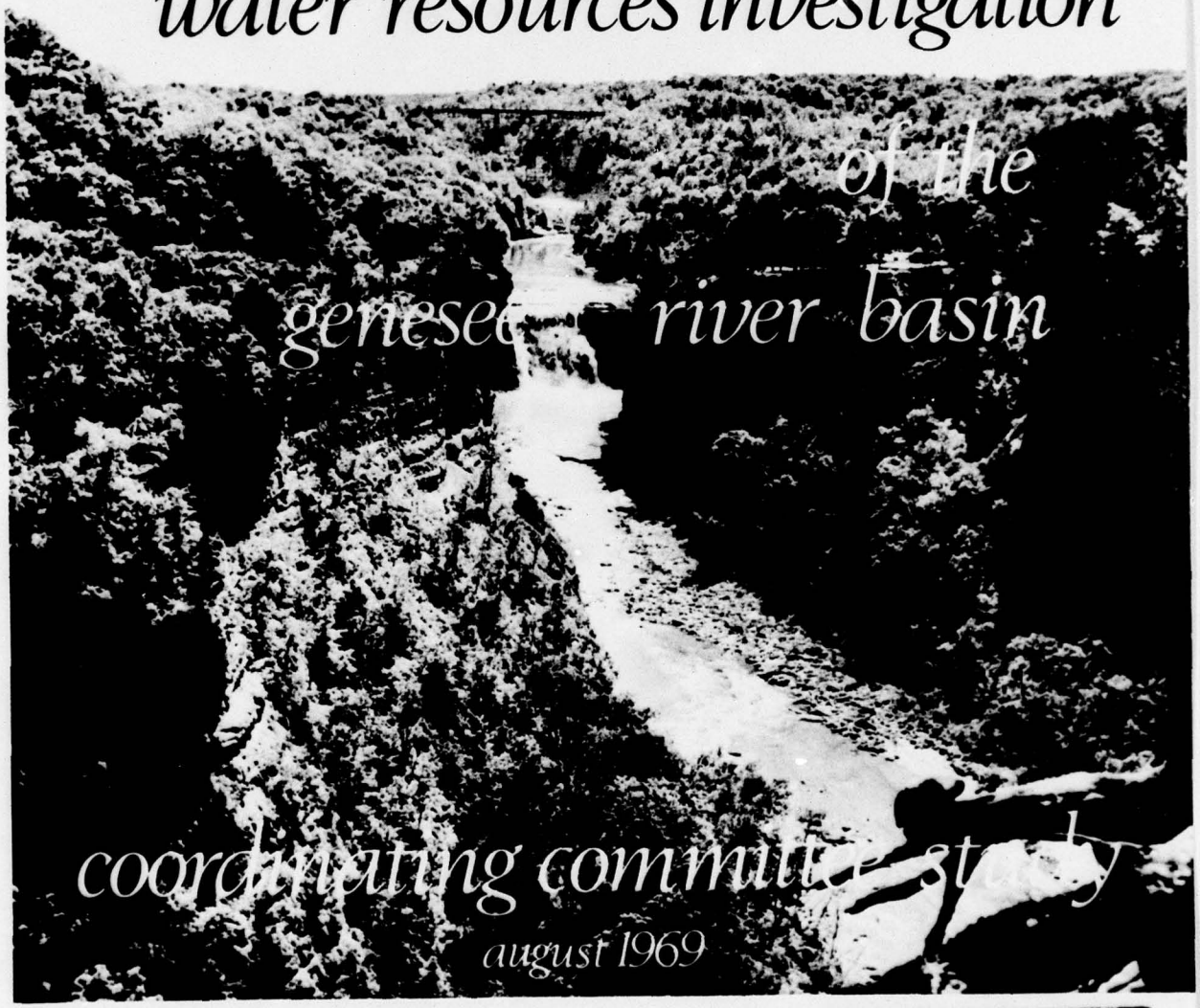

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The cooperation and assistance of many local, State and Federal agencies during the course of the investigations is gratefully acknowledged.

Appreciation is extended to the Buffalo District, Corps of Engineers, whose District Engineer served as chairman of the Genesee River Basin Study Coordinating Committee. Also the other Federal agencies represented on the Coordinating Committee contributed significantly to this supplement by providing basic data and other assistance. These include the Departments of Agriculture; Commerce; Health, Education and Welfare; and Interior; the Federal Power Commission; and the Commonwealth of Pennsylvania.

Mr. F. W. Montanari, Assistant Commissioner and Director, Division of Water Resources, New York State Conservation Department and Mr. Nicholas L. Barbarossa, Assistant Director of that Division, served respectively as Representative and Alternate for New York State on the Coordinating Committee.

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to the

WATER RESOURCES INVESTIGATIONS

of the

GENESEE RIVER BASIN COORDINATING COMMITTEE STUDY

Chapter I

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In the course of the Genesee River Basin Coordinating Committee Study, certain alternatives for multipurpose water resources development in the Basin were considered. For example, the Portage Project illustrated that, under the Federal ground rules for water resources project analysis, a particularly good physical site could be developed for: hydroelectric power, recreation and flow augmentation for water quality management. The development of upstream Genesee River Basin reservoirs for municipal and industrial water supply was not investigated in the previous volumes for reasons stated therein. The State of New York felt additional useful information would be gained by further analysis of municipal and industrial water supply, irrigation and hydroelectric power potentials. Therefore, to provide this additional information, the State of New York retained the services of consultants. Also, other possible sources of water supply, such as ground water and Lake Ontario, were analyzed in depth in this effort.

The Coordinating Committee Study followed existing Federal policies in plan formulation as dictated by Federal legislation. This procedure tends to limit the development of functions which could be implemented by non-Federal entities. For example, to include recreation in Federal projects at least 50 percent of the economic justification for the project must be met by purposes other than recreation. Other limitations include the maximum reservoir sizes of PL-566 projects and the present restrictions on the uses of these projects. State and, possibly, Federal legislation are required to allow for cost sharing on irrigation projects. Thus, the full range of opportunities for water resources developments in a river basin does not become apparent when analyzed within traditional Federal constraints.

In the Portage project, hydroelectric power is marginal. If hydroelectric were eliminated, the project's justification would hinge essentially on recreation, unless other uses are considered. Such reliance upon recreation for justification would eliminate it as a possibility for Federal development or financing under its current policies. This is an example of the effect of the Federal constraints.

Estimates for power installations at Portage are about equal in cost to alternative steam-electric peaking power, but are less attractive economically than other pumped-storage projects. Therefore, if the project is justified for other purposes, future hydroelectric power could be included to avoid losing a resource and would become functional only after more economical sources are developed. The analysis indicates that costs allocated to power are mostly specific costs. Hydroelectric power would be allocated only about 1.5 percent of the Portage Reservoir costs with the other functions bearing the remainder. Furthermore, the inclusion of power in conjunction with water supply (M&I) and irrigation imposes some penalties to recreation because of drawdowns, depending on the amount of water to be used by these other functions.

If power were to be eliminated, recreation benefits would constitute about 95 percent of the demonstration project's justification. This project would not conform to present Federal financing policy under which at least 50 percent of its justification must be furnished by uses other than recreation. However, the project or any other reservoir should not necessarily be eliminated from consideration for recreational development by this limitation. Such development could be accomplished by non-Federal interests or on a sharing basis with the Federal Government if new legislation would premit. Significant benefits may be obtained from such uses as municipal and industrial water supply and irrigation. Evaluation of these additional functions can provide benefits substantially in excess of those estimated to date.

In the Portage project, it is estimated that pump-back power, municipal and industrial water supply and water quality management in the year 2020 can be fully obtained in an average year with a seasonal drawdown by September 1 of 4.5 feet. Drawdowns of 10.0 feet once in 5 years and 14.5 feet once in 10 years can be expected. If pump-back power is eliminated, the project needs for the year 2020, including irrigation for 24,000 acres, can be met completely, with drawdowns of 6.0 feet for an average year and 14.5 feet once in 10 years. If irrigation supply is extended to 50,000 acres or doubled, and M&I water needs for 1980 are met, the October 1st drawdown expected once in 10 years would be 10.5 feet, without power. For a detailed tabulation of drawdowns, see Table IV-16.

The greatest net benefits from potential Genesee River reservoirs appear to be in their multiple use for municipal and industrial water supply, irrigation, recreation and water quality management. In such multiple use, drawdowns greater than the limit of five feet would be accepted during infrequent years of short water supply.

A number of potential sites for such multipurpose reservoir development were identified in the Basin. They are listed in the attachment and have been considered in other volumes under Federal criteria. However, these developments should be considered in more detail in the formulation of a more comprehensive Basin plan. With the introduction of these new considerations, evaluations should be done on a systems basis, in order to provide a multipurpose plan for meeting future needs which considers the interrelated operational effects of the various projects.

Pump-storage projects to meet power needs, such as that illustrated above, also could provide flood control and offer ideal possibilities for recreation and conservation as well. The reservoir at upper left is the storage facility for power needs; at right is the typical dam and main reservoir for such a project, which could be adapted for both conservation and recreation.

Recommendations

The following actions are recommended by the State of New York for refinements of the basin plan, the commitment of funds to definite projects and the selection of projects for implementation:

(1) Refinement of the Plan

It is felt that there is enough data available to start refining the multipurpose plan for the Basin. Further data refinement is needed in selected areas and this could be accomplished as the plan is further developed and implemented.

(2) Investigation for Projects

Specific projects to more fully meet Basin needs must be developed.

(3) Implementation of the Refined Plan

The measures required to implement the refined plan and its separate elements must be evolved.

(4) Projects for Implementation

These include projects and other measures that should be immediately authorized and developed early.

Specific aspects of these recommendations are:

(1) Refinement of the Plan

Most of the basic investigations required for preparation of the refined multipurpose basin plan have been completed. This supplement provides development of: Municipal and industrial (M&I) water from the Genesee River; irrigation using either Genesee Reservoir supplies, groundwater or Lake Ontario; and hydroelectric power.

Refinement of information to be developed by further studies should include:

(a) Additional market surveys for present and future demand for water-oriented recreation and fish and wildlife facilities and their impact on multipurpose development.

Recreational needs are an important consideration in water resource planning. Shown here is a boys' camp operated by the New York State Conservation Department at Rushford Reservoir in the Genesee River Basin.

(b) The relationship of reservoir seasonal drawdown to recreation quality and recreation benefits of potential multipurpose reservoir sites in the Basin. Benefits should be estimated for a range of maximum drawdowns varying from about 5 up to 25 feet, as well as for the frequency with which drawdowns occur.

(c) Evaluation of the broad economic impacts in the basin and region of alternative water resource development programs. In particular, the impacts of recreation-oriented programs and irrigation-oriented programs should be studied.

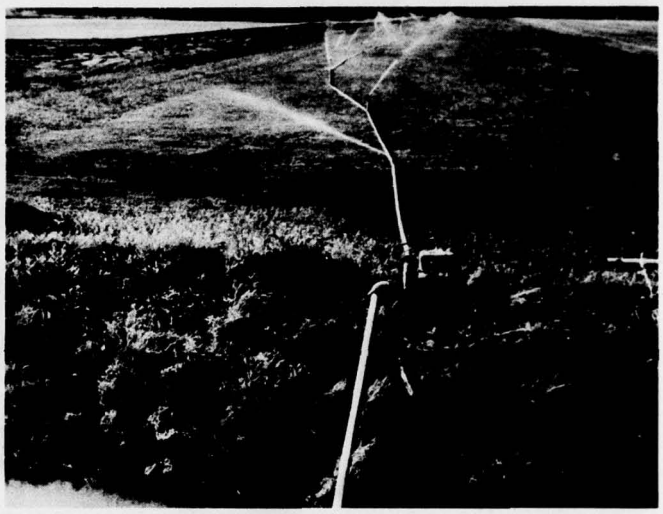
(d) A systemized approach to the functional and developmental requirements of the Basin. This is needed before a multipurpose water resource plan can be formulated. The Portage reservoir operation studies which were performed to meet downstream uses, with and without power, are an example of the basin input needed. Additional studies should include evaluations of benefits and costs supplemented, as appropriate, by such considerations as intangible benefits and the priority of need for alternative uses.

The investigations need only be to the level necessary to make comparative appraisals among alternatives that would be considered in the short-range part (to 1985) of the plan. Those alternatives in the long-range part (1985-2020) of the

plan need only be defined as potentials. The short-range elements should consist of the best possible measures to meet immediate needs. Also, the most promising potentials of the long-range plan should not be precluded by the initial steps that are undertaken.

(2) Investigations of Projects

Studies will be required for the selection of initial developments in the multipurpose plan. A variety of elements will need to be analyzed in greater detail. These elements include not only the physical, but the functional features of projects as well. Economic evaluations of costs and benefits of alternatives must be made on a functional and project basis, in order to develop the best multipurpose plan.



Irrigation water needs and resources, and the economic advantages of increased irrigation in both the Lake Ontario West Basin and the Genesee River Basin should be considered further in formulating a multipurpose plan for the Genesee River Basin.

The elements to be analyzed in detail will vary with the developments selected. As an example, for refinement of the comparisons of reservoirs and other alternatives, these studies should include:

(a) Refinement of sustained groundwater yield potentials on the basis of aquifer mapping, thickness determinations and well tests. This will allow analyses of long-term yield potentials, well capacities, long-term effects on water tables and streamflow and ground water management needs. These investigations are needed in the Genesee River Basin to confirm the availability of irrigation water in Areas 2 and 3 (see Plate 3) and to

indicate specific areas in which groundwater would be more economical for irrigation than stored surface water.

(b) Economic impact studies on individual projects to indicate the net economic change (both negative and positive) that would likely occur from a project's impact on its area of influence.

(c) Further land classification and drainage studies to include the determination of land development costs in specific areas of the Lake Ontario Plain which have been classified as irrigable and could be served from upstream reservoirs.

(d) Analysis of the Barge Canal's capabilities for further diversions and conveyance of Genesee River Basin water. This would include potential reregulating storage in connection with the diversions which would expand the irrigation project area above 24,000 acres. Also, comparison of Lake Ontario and Genesee River Basin reservoirs as sources of supply is needed for specific areas in the Lake Ontario West Basin.

(e) Refinement of municipal and industrial water supply investigations to include comparison of specific reser-

The Barge Canal, now primarily a water-traffic route, could have truly multiple use, including conveyance of irrigation water to the Lake Ontario West Basin, if additional water is routed to the Canal from Genesee River Basin reservoirs.

Hamlin Beach State Park on Lake Ontario just west of Rochester. Reservoirs in the Genesee River Basin can supplement the Lake to meet Rochester's future requirements for municipal and industrial water supply and water-based recreation.

voir projects with Lake Ontario as a source of supply. Various levels of water supply needs and phase developments would be considered in a systems approach.

(f) Development of an optimized plan of reservoir operation and use, based on costs and on tangible and intangible benefits.

(3) Implementation of the Refined Plan

In addition to the engineering, economic and other resource studies described above, it is necessary to provide the means for local participation in the development of the Basin's multipurpose water resource plan. This can be accomplished through the Genesee Basin Regional Water Resources Planning Board, consisting of local public officials and prominent citizens. Ten other, similar boards have been established and are operating in other basins of the State. The Regional Board provides policy guidance to multipurpose planning activities. One of its functions is to disseminate to the public, information relative to the desirability of various alternatives, allowing opportunity for choices. The Board represents public desires and participates in se-

lection of the elements in the recommended plan from formulated alternatives.

Consideration of the best means of implementing the recommended plan should include:

(a) Organizational arrangements required to implement the overall Basin plan and its separate elements; e.g., irrigation.

(b) Financial analyses to determine sources and capabilities for financing the plan and its individual projects.

(4) Projects for Implementation

The multipurpose Canaseraga project for reduction of agricultural flooding and wildlife conservation; 35 headwater reservoirs in the Genesee Basin; and 29 upland irrigation reservoirs in the Lake Ontario West Basin (see Plate 4) are recommended for immediate authorization and early development. In addition, three waterfowl areas; eight river access sites for boating; one flood plain management area; a natural historical area; and an agricultural land treatment program, all as indicated in the Coordinating Committee proposal, should be part of the short-range plan of development.

Additional studies made in conjunction with the Water Development Committee for Appalachia indicate that the Stannard Reservoir Project may be part of an initial developmental program. Accordingly, Stannard is tentatively included in the short-range plan. Additional measures, including other reservoirs, may be included in the short-range plan subject to the findings of further studies. No attempt has been made at this time to indicate the measures which should be included in the long-range plan for development of the Basin's water resources. The Regional Water Resources Planning Board Studies will develop the overall Basin Plan.

CHAPTER II

Introduction

A comprehensive water resources study of the Genesee River Basin was authorized on February 1, 1962 by a resolution of the Committee on Public Works of the United States Senate. To achieve interagency cooperation, the Genesee River Basin Coordinating Committee was formed to conduct a study generally in accordance with the guidelines of the Interdepartmental Staff Committee of the then ad hoc Water Resources Council. The Buffalo District Engineer, Corps of Engineers has served as chairman of the Committee and its members include representatives from numerous Federal agencies, the State of New York and the Commonwealth of Pennsylvania.

The comprehensive water resources study was designed to be accomplished essentially in two phases. The first phase, undertaken by task groups, was to prepare a series of individual reports on specific subject areas. These task group reports were to provide basic economic and engineering data and information on functional aspects for use during the plan formulation phase of the study. Task group reports were scheduled for completion by December 1966. The Corps of Engineers had primary responsibility for conducting the plan formulation phase which was to be completed by June 1967.

A number of factors prevented completion of the task group studies on schedule; therefore, plan formulation could not be completed by June 1967. The Coordinating Committee, strongly supported by the State of New York and its other members requested an extension of time and additional funds to allow for completion of the comprehensive study. However, higher Federal authorities decided that a time extension could not be granted. As a result, it was possible to formulate only a limited number of alternatives. Accordingly, a wide range of water resources development alternatives are not available at this time for public consideration.

New York State agencies contributed to several task reports as part of the State's participation in the Coordinating Committee Study. Reports assigned to State agencies for their completion are: The "Economic Base," Appendix D, by the Division of Water Resources, Department of Conservation; "Water Supply and Water Quality Management," Appendix H, by the Health Department; and "Recreation," Appendix M, by the Division of Parks of the Department of Conservation.

In addition to task assignments, this document represents another part of the State's input to the study. The information presented herein is supplementary to that developed by the Committee's task

groups and it was not available in time for extensive use in the Coordinating Committee report. However, it is available to provide direction for use in any future planning studies. These supplemental investigations were primarily concerned with more detailed studies of: (1) Functional needs such as hydroelectric power, irrigation, and municipal and industrial water supply, (2) the developmental potentials of Genesee River reservoirs and other sources to meet the functional needs cited in (1) above, and (3) a preliminary analysis of potential projects and other measures in a context free of existing Federal and other legislative, administrative and technical constraints.

In order to complement the Committee Study, which focused, during its brief time for plan formulation, on investigation of the Portage site; the State's studies used Portage as a demonstration project.

However, the conclusions are in a large measure applicable to other Genesee River Basin reservoirs which are potential water resource developments. The extent of the State studies are summarized herein and described in detail in the following ten planning memoranda:

1. Power - Load Curve Analysis
2. Power - Pumped-Storage Site Study
3. Power - Portage Development
4. Irrigation - Irrigability Criteria and Land Classification
5. Irrigation - Surface Water Supply Costs
6. Irrigation - Ground Water Supply
7. Irrigation - Agricultural Economics
8. Municipal Water Supply for the Rochester Metropolitan Area
9. Portage Reservoir Operations Studies
10. New York State Barge Canal Studies

CHAPTER III

POTENTIAL WATER RESOURCE USES

The surface and ground water resources of the Basin can be managed for a variety of potential uses. Some of these are: flood control, municipal and industrial (M&I) water supply, water quality management, outdoor recreation, fish and wildlife preservation and enhancement, and hydroelectric power.

The availability of, and needs for, water and related land resources in the Basin were evaluated by the Coordinating Committee's task groups. Their investigations are documented in appendices to the Committee's report. This chapter presents general background information on the investigations of the Coordinating Committee and the supplementary work of New York State. As stated previously, studies by the State were limited to hydroelectric power, irrigated agriculture and municipal and industrial water supply.

Water Resources

Surface Water

The surface waters of the Genesee River Basin flow into Lake Ontario at Rochester (see Plate 1). The average annual yield of water from the Genesee River system is about 1.8 million acre-feet, equivalent to a steady flow of about 1650[1] mgd. About 50 percent of this flow occurs during the snow-melt period from February through April, and only about 10 percent occurs during the summer months of June through August. The minimum recorded flow of the Genesee River at Rochester is 220 cfs, or about 150 mgd, part of which probably was from the Barge Canal. Reservoir sites on the main stem and tributaries have enough potential storage to regulate the minimum flow of the river to as much as 1,000 mgd[2].

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[1] Average flow USGS station at Driving Park Avenue, Rochester, adjusted for assumed diversion from Barge Canal of 375 cfs for 8 months.

[2] From storage-yield analysis by USGS. Storage required for 1,000 mgd at Rochester at 20-year recurrence is about 380,000 acre-feet.

The New York State Barge Canal flows from west to east across the Basin. During the navigation season, 375 cfs are diverted from it to the Genesee River upstream from Rochester for power generation and cooling water. This diversion augments low flows and improves water quality in that part of the Genesee River.

Also, during the summer low-flow season, Rochester Gas and Electric Company uses Rushford Lake on Caneadea Creek to supplement the flow of the Genesee River.

Ground Water

Groundwater potentials of the Genesee and Lake Ontario West Basins were investigated by the U. S. Geological Survey as part of the Coordinating Committee Study. In the Genesee Basin a substantial groundwater resource exists and it is generally limited to the unconsolidated sand and gravel aquifers. Surficial deposits which could be reasonably expected to be capable of supporting wells of 400 gpm capacity, a minimum for irrigation development, have been mapped by the USGS. Bedrock well yields are generally low and ordinarily would not be suitable for large scale uses such as irrigation supply. Bedrock well yields vary from 25 to 100 gpm.

In the Lake Ontario West Basin, groundwater is generally very poor in both quantity and quality. Its potential long-term yield is estimated to be about 150 mgd, of which about 5 mgd is presently developed. Surficial deposits in this Basin are generally not suitable for large scale groundwater development and bedrock yields are even lower than in the Genesee Basin. Accordingly, groundwater was not considered as a significant water resource in the Lake Ontario West Basin.

Irrigable Land Resources

Rainfall in the Genesee River and the Lake Ontario West Basins during the crop growing season is not adequate in quantity or distribution to produce optimum crop yields every year. Hence irrigation represents a potential major use of water.

It is possible to irrigate lands in the Lake Ontario West Basin, north of the Barge Canal, by replacing water diverted from the Barge Canal with Genesee River water. Therefore, the land resources of both basins must be considered in evaluating the use of water from the Genesee Basin. At present, supplemental irrigation is practiced on about 5,200 acres in the Genesee River Basin, and on about 5,500 acres in the Lake Ontario West Basin. Soils and topography are

suitable for sprinkler-type irrigation on large areas of land in both basins. Estimates of irrigable land area which could be served by gravity from Genesee River reservoirs range from about 230,000 to 460,000 acres.

Water Resource Needs and Opportunities

Municipal and industrial water supply and water quality management are needs essential to the economy and environment of the Basin. However, opportunities also exist for use of the Basin's water resources for recreation, irrigation, flood control and hydroelectric power generation.

Municipal and Industrial Water Supply

The need for municipal and industrial water supply is concentrated in the Rochester-Monroe County area. The total demand on the City of Rochester system in 1965 was 48 mgd. The City received 28 mgd of its water supply from Hemlock and Canaidice Lakes with the remaining 20 mgd obtained from Lake Ontario. In 1965 the Monroe County Water Authority supplied 30 mgd to the County area entirely from Lake Ontario. The bulk of the industrial water supply obtained outside of the municipal water supply systems (183 mgd in 1965) is from Lake Ontario. The projected municipal water supply requirement of the Rochester metropolitan area is 275 mgd by the year 2020 which is over 90 percent of the basin's total requirement. The incremental water requirements after 1980 can be supplied either from Lake Ontario or from the Genesee River. Small municipal water supply systems scattered throughout the basin can in general meet their present and forecast needs primarily from groundwater sources.

Recreation

The western region of New York State has many opportunities for water-oriented recreation, including both Lakes Erie and Ontario and a number of inland lakes. Lake Ontario and Lake Erie support large recreation usage, although both are limited somewhat by such factors as access, pollution, winds, and rough waters. Lake Ontario also has a limitation resulting from low water temperatures. The inland lakes accomodate large recreation use, but most of them have patterns of private ownership which severely limits public access.

There are many potentials for water-oriented recreation development, both within and near the Genesee Basin. All of the multipurpose and single purpose reservoirs investigated by the Coordinating Committee Study have potentials for recreation. There are also many opportunities for fish and wildlife preservation and enhancement through reservoir development and stream improvements.

Besides reservoir potentials, further development of recreational facilities at some of the Basin's inland lakes also represents an alternative for satisfying recreation demands. In addition, development of potential reservoir and lake sites in basins to the east and west of the Genesee and possibilities for new recreation areas along Lakes Erie and Ontario present other choices.

Irrigation

The practice of supplemental irrigation in humid zone agriculture, particularly by means of sprinkler systems, has grown rapidly. Supplemental irrigation increases the probability of obtaining a successful crop in years when rainfall is inadequate, and it improves the type and quality of crops, particularly for the freezing and canning industries. Supplemental irrigation of high value crops is increasing in the western part of New York State; this potential for high quality crop production has attracted several food processing industries to the region. The expanding market for agricultural products and the increasing urban pressures on present agricultural lands require increased yields from remaining lands. This indicates an increased opportunity for irrigation in the Genesee and Lake Ontario West Basins.

As a part of the Coordinating Committee Study, the Economic Research Service (ERS) of the Department of Agriculture analyzed the crop production requirements of the Genesee River and the Lake Ontario West Basins. ERS projected the future acreage needed to meet production requirements at their forecasted yields. The forecasting methods used by the ERS basically project the share of agricultural production in the nation, with adjustments both local and national for conversion of land use from agriculture to urban and other purposes.

Water Quality Management

Water quality problems in the Genesee River Basin are centered in the Rochester area. Desired water quality standards can be met by such means as increasing the level of waste treatment, by increasing low flows of streams to provide dilution water, or by outfall relocation. With conventional secondary waste treatment, (about 85% removal of BOD) it is estimated that a flow of 830 cubic feet per second in the year 2020 would be needed to assimilate waste discharges in the Genesee at Rochester. If the level of waste treatment is raised to 95 percent removal of BOD, indications are that no flow augmentation would be required. Augmentation for water quality control was recommended at Avon and Gates-Chili-Ogden, Mill Creek at Wayland, Wilkins Creek at Livonia, Oatka Creek at Warsaw and at the outlets of Conesus and Silver Lakes.

Hydroelectric Power

The need for electric power increases progressively from year to year and forecasted needs far exceed any conventional hydroelectric potential in the region. It can be safely assumed that any source of conventional hydroelectric power which is competitive with alternative sources can be considered as usable on the market. Portage is the only site in the Genesee River Basin that offers any significant opportunity for development of conventional hydroelectric power and the potential of this site could be easily absorbed by the market, if it were economically competitive.

A considerable potential for pumped storage hydroelectric power, primarily for supplying peak power demands exists in the Basin. These possibilities, worthy of further study, exist both in conjunction with reservoir projects and with natural lakes.

Flood Control

Mount Morris reservoir which controls about 44 percent of the basin's drainage, provides almost complete flood protection to Rochester. Except for the damages to agricultural land in the Canaseraga Creek Valley, the residual flood damages in the Basin are generally minor and scattered. The Coordinating Committee Study proposes a multi-purpose local protection project for Canaseraga Creek to alleviate the flood problem and to provide for fish and wildlife enhancement. Also, flood plain management was proposed by the Coordinating Committee for the damage area at the confluence of Black Creek and the Genesee River.

Chapter IV

ANALYSIS OF ALTERNATIVE DEVELOPMENT POTENTIALS

Introduction

The plan formulation phase described in Appendix B of the Coordinating Committee report considered such purposes as: power generation, flood control, recreation, water quality management, and fish and wildlife conservation. An essential part of the Committee study was the formulation of the Portage Project, principally from the standpoint of power, recreation and water quality management. Also, Canaseraga Project is proposed as a multipurpose development for reduction of agricultural flooding and for wildlife conservation. Other elements of the Committee plan include 35 headwater reservoirs in the Genesee River Basin and 29 small irrigation reservoirs in the Lake Ontario West Basin. In addition, three waterfowl areas, eight river access sites for boating, a natural history area, one flood plain management area and an agricultural land treatment program are proposed (see Plate 4).

This chapter presents functional alternatives to the water resource development potentials proposed by the Coordinating Committee. These supplementary studies are focused primarily on alternative opportunities for utilization of large scale reservoir storage in the Genesee River Basin.

The Committee investigated major reservoir sites at Portageville, Stannard and Belfast on the Genesee River; Angelica, Angelica Creek; Tuscarora, Keshequa Creek; and Wiscoy, Wiscoy Creek. The storage-cost functions for these sites, excepting Wiscoy, are shown on Figure B-5 in Appendix B to the Committee's report. They indicate that Portage Reservoir would be the least costly on a storage basis. All of these reservoirs can be considered as alternatives for meeting such functions as irrigation, water quality management, and municipal and industrial water supply. Portage reservoir site has unique characteristics for pumped storage power and for recreation. Most of the upstream multipurpose reservoirs have minor flood control potential.

Cost Allocations

Cost allocations for the reservoir projects were made by the Separable Cost-Remaining Benefits (SCRB) method. These results for Portage are presented in the preliminary draft of Appendix B to the Coordinating Committee's report, on page IV-B39. The allocation apportioned the joint costs between power, recreation and water quality management.

In accordance with current Federal practice, the joint costs were allocated to each purpose in direct proportion to the benefits which remain after each purpose's separable costs are subtracted from the lesser of the benefits or the alternative cost.

The State did not undertake plan or project formulation in its supplementary studies. However, two preliminary cost allocations were made for the Portage Demonstration Project in order to determine the relative effects of adding irrigation, and municipal and industrial water supply as project functions. Benefits and costs developed by the Coordinating Committee Study were utilized to the maximum extent possible; so that the allocations would be comparable to those of the Committee Study.

The two cost allocations, included adding irrigation, and municipal and industrial water supply to the existing recreation and water quality management functions. One allocation was made with power as a function and the other without power. For the power, recreation and water quality functions, the State used the benefits and costs developed by the Coordinating Committee in its cost allocations. However, it is recognized that both the costs and benefits to all of the functions would be somewhat different if actual project formulation had been undertaken. This is particularly true in the case of the project without power, as a smaller scaled reservoir project would probably result.

The benefits and costs for irrigation, and municipal and industrial water supply used in the allocations are described later in this chapter. Irrigation benefits and costs were based on the requirements of 24,000 acres in the Lake Ontario West Basin for water from the Genesee conveyed by the Barge Canal. Municipal and industrial water supply benefits and costs were based on the incremental requirements of the Rochester Metropolitan Area for a staged supply from 1980 to 2020. Interest rates and amortization periods were adjusted to be consistent with those used by the Coordinating Committee.

The additional allocations are presented in Tables IV-1, 2 and 3. Table IV-4 presents a comparison of the cost allocation summaries. The results of the additional cost allocations would be different if the benefits from power as developed by the State and presented later in this chapter had been used. However, regardless of which value is used, it is apparent from the comparison in Table IV-4 that power has little effect on the costs allocated to other project purposes. This is because most of the power costs are separable costs. However, the cost allocations that include irrigation and water supply (M&I) reduce the allocated costs to recreation and water quality by $4.5 million (33%) and $1.6 million (44%) respectively.

Development Possibilities and Alternatives

Flood Control

Mount Morris reservoir has provided flood protection to Rochester to the extent that its residual average annual damages are estimated to be $5,000. The Coordinating Committee did not suggest any change in the flood storage at Mount Morris. However, if Portage reservoir is used for pumped-storage with the existing Mount Morris as the lower reservoir, flood control storage would be needed in Portage to substitute for storage reduction in Mount Morris.

The Basin's largest single damage center with remaining average annual flood damages of $94,000 is the agricultural area of the Canaseraga Creek Valley. The project proposed by the Coordinating Committee would consist of enlargement and straightening of approximately 20 miles of channels, a retention structure near the downstream end of the project area and fish and wildlife ponds upstream from the retention structure. The proposed project would furnish flood protection to 4,700 acres of agricultural land for an estimated average annual benefit including land enhancement, of $195,000. An average annual benefit of about $198,000 was estimated for the fish and wildlife aspects of the project.

Significant and growing flood damage potential exists on the flood plains of tributary streams in the Rochester metropolitan area, particularly Black Creek and Red Creek. The solution proposed for Black Creek is to carry out a flood plain management program. A local flood protection project has been authorized by Congress for the Red Creek problem area. Average annual flood damages were estimated at $39,000 at Warsaw on Oatka Creek. At Wellsville, on the main stem of the Genesee, the average annual damage is estimated to be $24,000. Construction of local flood protection improvements has been authorized for and plans and specifications are being prepared for Wellsville. Construction of a local protection project at Warsaw was completed recently. The remaining flood damages in the Basin are small and scattered and they are mostly damages to agriculture. The Coordinating Committee study concluded that alleviating these flood damages by structural means is not justified.

Power

The Coordinating Committee investigated potentials for hydroelectric development at reservoir sites in the Genesee River Basin. It concluded that the only potential for conventional hydroelectric power exists at Portage. The Coordinating Committee's proposals for

Table IV-1

PORTAGE DEMONSTRATION PROJECT
SUMMARY OF FIRST COSTS AND ANNUAL CHARGES
(Costs in 1,000 Dollars)
Multiple - Purpose Project

	Power	Recreation	Water Quality[1]	Irrigation	M & I Water	Joint	Total
First Costs							
Lands and damages	70[2]	1,715	-	-	-	3,055	4,840
Dam and reservoir	650[2]	-	-	-	-	32,150	32,800
Power facilities	44,500	-	-	-	-	-	44,500
Recreation facilities[3]	-	8,865	-	-	-	-	8,865
Irrigation facilities	-	-	-	8,832	-	-	8,832
M & I Facilities[4]	-	-	-	-	51,771	-	51,771
Total	45,220	10,580	0	8,832	51,771	35,205	151,608
Investment							
Interest during const.[5]	2,940	570[6]	-	287	749[7]	2,285	6,831
Investment	48,160	11,150	0	9,119	52,520	37,490	158,439
Alternative for single purpose project	-	-	3,480	7,356	61,741	-	-
Annual Charges							
Interest (3⅛%)	1,565	362	-	296	1,683	1,219	5,125
Amortization (100 yr.)	67	15	-	13	72	52	219
Operation and Main.	557[8]	855	-	200	805	69	2,486
Major Replacements	111	78	-	153	214	-	556
Admin. and General	162	-	-	-	-	-	162
Pumping Energy	448	180[9]		72	455	-	1,155
Totals	2,910	1,490	0	734	3,229	1,340	9,703
Alternative for single purpose project	2,949[10]	2,740[11]	138[12]	827[13]	4,285[14]	-	-

Footnotes on next page

Table IV-1 (Cont'd)

PORTAGE DEMONSTRATION PROJECT

SUMMARY OF FIRST COSTS AND ANNUAL CHARGES

Footnotes

1/ For Genesee River reaches below Avon and Gates-Chili-Ogden outfall
2/ Incremental cost for flood control storage displaced in Mt. Morris reservoir between elev. 680 and elev. 697 for power
3/ Includes present worth of future facilities
4/ Includes present worth of facilities to be constructed in 1990, 2000 and 2010
5/ Four-year construction period at 3¼ percent interest rate, except for irrigation and M & I Water where a two year construction period was used
6/ For initial recreational facilities cost
7/ For first stage M & I facilities cost
8/ Includes interim replacements for power facilities
9/ Increased cost of pumping energy due to 225 cfs for Letchworth Park falls
10/ Based on costs for federally-financed steam alternative
11/ Single-purpose project at Portage site
12/ Two alternative Soil Conservation Service Reservoirs
13/ Ground water irrigation in Genesee Basin
14/ Using Lake Ontario as the municipal water source

Table IV-2

PORTAGE DEMONSTRATION PROJECT

COST ALLOCATION

(Costs in 1,000 Dollars)

Allocation of Annual Costs	Power	Recreation	Water Quality	Irrigation	M & I Water	Total
Benefits	4,766	2,964	138	1,548	4,285	13,701
Alternate Cost	2,949	2,740	138	827	4,285	10,939
Benefits limited by alternate cost	2,949	2,740	138	827	4,285	10,939
*Separable cost	2,910	1,490	0	734	3,229	8,363
Remaining Benefits	39	1,250	138	93	1,056	2,576
Allocated joint costs	20	650	72	49	549	1,340
Total allocated cost	2,930	2,140	72	783	3,778	9,703
Benefit to Cost Ratio	1.63	1.39	1.92	1.98	1.13	1.41
Allocation of Operation & Maint. Costs						
Specific Costs	557	855	0	200	805	2,417
Allocated joint cost	1	33	4	3	28	69
Total allocated cost, O& M	558	888	4	203	833	2,486
Major Replacements, Administration and General, Pumping Energy - (Specific Costs)	721	258	0	225	669	1,873
Allocation of Investment (Annual)						
Specific Costs	1,632	377	0	309	1,755	4,073
Allocated joint cost	19	617	68	46	521	1,271
Total annual investment cost	1,651	994	68	355	2,276	5,344
Allocation of Investment (Total)						
Specific Costs	45,220	10,580	0	8,832	51,771	116,403
Interest during construction	2,940	570	0	287	749	4,546
Total specific investment cost	48,160	11,150		9,119	52,520	120,949
Allocated joint facilities cost	525	17,080	1,890	1,290	14,420	35,205
Allocated joint interest on facilities cost	34	1,108	123	84	936	2,285
Total allocated joint investment cost	559	18,188	2,013	1,374	15,356	37,490
GRAND TOTAL ALLOCATED INVESTMENT	48,719	29,338	2,013	10,493	67,876	158,439
Allocation of Construction Expenditures						
Construction, specific facilities	45,220	10,580	-	8,832	51,771	116,403
Construction, joint facilities	525	17,080	1,890	1,290	14,120	35,205
Total construction expenditures	45,745	27,660	1,890	10,122	66,191	151,608

*Specific costs used in lieu of separable costs.

power at Portage consist of: (1) conventional hydroelectric power at Portage, (2) a pump-back, pumped-storage development using Portage as the upper reservoir and Mount Morris as the lower reservoir, and (3) a pumped-storage development using Mount Morris as the lower reservoir in conjunction with a separate upper reservoir. It was concluded that the sustained flows of the Genesee River, even with storage regulation, were not adequate to support a conventional hydroelectric power development.

The Coordinating Committee concluded that the pump-back pumped-storage scheme, utilizing an underground powerhouse between the two reservoirs, was economically feasible at an installed capacity of 200,000 kilowatts. Higher installed capacities were investigated for the pump-back scheme but it was found that the comparability ratio (based on cost of power from a Federally-financed steam plant) fell below 1.0 for capacities above 200,000 kilowatts. The pumped-storage scheme utilizing Mount Morris as the lower reservoir and having a capacity of 310,000 kilowatts was investigated. However, this scheme does not have the benefit of the natural flow of the Genesee River. The Coordinating Committee concluded that the pump-back alternative was the most feasible alternative.

The State also found that conventional hydroelectric power is uneconomical at any site in the Genesee River Basin. A review also was made of the cost estimate prepared by the Coordinating Committee for the pump-back power facilities at Portage. The geologic situation of the underground powerhouse was investigated both from exploratory data collected by other agencies and through field examination of the site. It was found that the alignment of the underground facilities as originally proposed would be affected by a buried glacial valley and it was concluded by the State's consultant that the alignment presented by the Coordinating Committee should be avoided. Alternative layouts were prepared to avoid the geologic problem areas and cost estimates were made for them. Although the physical location of facilities differed from that presented by the Coordinating Committee, it was concluded that an installation of 200,000 kilowatt capacity could be made for approximately the same cost as that estimated by the Coordinating Committee. It was further concluded that the power facilities of other layout alternatives could not be developed at a lesser cost.

Pumped-Storage Alternatives

Since the Coordinating Committee did not evaluate pumped-storage alternatives independent of the Portage-Mount Morris potential, the State's supplementary studies included an investigation of

Table IV-3

PORTAGE DEMONSTRATION PROJECT
COST ALLOCATION
(Costs in 1,000 Dollars)

Allocation of Annual Costs	Recreation	Water Quality	Irrigation	M&I Water	Total
Benefits	2,964	138	1,548	4,285	8,935
Alternate Cost	2,740	138	827	4,285	7,990
Benefits limited by alternate cost	2,740	138	827	4,285	7,990
*Specific cost	1,490	0	734	3,229	5,453
Remaining benefits	1,250	138	93	1,056	2,537
Allocated joint costs	660	73	49	558	1,340
Total allocated cost	2,150	73	783	3,787	6,793
Benefit to cost ratio	1.38	1.89	1.98	1.13	1.32
Allocation of Operation & Maint Cost					
Specific costs	855	0	200	805	1,860
Allocated joint cost	34	4	2	29	69
Total allocated cost, O & M	889	4	202	834	1,929
Major Replacements, Administration and General, Pumping Energy - (Specific Costs)	258	0	225	669	1,152
Allocation of Investment (Annual)					
Specific cost	377	0	309	1,755	2,441
Allocated joint cost	626	69	47	529	1,271
Total annual investment cost	1,003	69	356	2,284	3,712
Allocation of Investment (Total)					
Specific costs	10,580	0	8,832	51,771	71,183
Interest during construction	570	0	287	749	1,606
Total specific investment cost	11,150	0	9,119	52,520	72,789
Allocated joint facilities cost	17,340	1,920	1,290	14,655	35,205
Allocated joint interest on facilities cost	1,125	125	84	951	2,285
Total allocated joint investment cost	18,465	2,045	1,374	15,606	37,490
Grand Total Allocated Investment	29,615	2,045	10,493	68,126	110,279
Allocation of Construction Expenditures					
Construction, specific facilities	10,580	-	8,832	51,771	71,183
Construction, joint facilities	17,340	1,920	1,290	14,655	35,205
Total construction expenditures	27,920	1,920	10,122	66,426	106,388

* Specific costs used in lieu of separable costs.

Table IV-4

PORTAGE DEMONSTRATION PROJECT

COMPARISON OF THE COST ALLOCATION SUMMARIES

(Investment Costs in 1,000 Dollars)

Purpose	Coordinating Committee			NYS Alt. w/Power			NYS Alt. w/o Power		
	Specific	Joint	Total	Specific	Joint	Total	Specific	Joint	Total
Power	48,160	1,020	49,180	48,160	559	48,719	---	---	---
Recreation	11,150	32,840	43,990	11,150	18,188	29,338	11,150	18,465	29,615
Water Quality	---	3,630	3,630	---	2,013	2,013	---	2,045	2,045
Irrigation	---	---	---	9,119	1,374	10,493	9,119	1,374	10,493
M & I Water	---	---	---	52,520	15,356	67,876	52,520	15,606	68,126
TOTAL	59,310	37,490	96,800	120,949	37,490	158,439	72,789	37,490	110,279

potential sites elsewhere in the basin. Several promising sites were identified from a map study. A field reconnaissance was then made of those sites appearing to have the lowest investment cost per kilowatt of installed capacity. Preliminary layouts and cost estimates were prepared for these sites. Their locations are indicated on Plate 2, and their cost estimates are summarized in Table IV-5.

Table IV-5

POSSIBLE PUMPED-STORAGE PROJECTS

Project Site	Installed Generating Capacity Megawatts	Estimated Investment Cost $ per kilowatt
Canadice Hill	1000	106
Grove	500	120
East Hill	700	125
Marrowback Hill	500	128
Bald Hill	400	130
Barbar Hill	350	141
Turkey Hill	300	165
Mt. Morris pumped storage (Plan D)	310	156[1]
Portage-Mt. Morris pump-back (Plan C)[3]	200	249[2]

---

1 Independent cost estimate by State's consultant, does not include joint facilities cost allocation - should be compared with $149, given in Table L-13 of Appendix L, Coordinating Committee Report.

2 Independent cost estimate by State's consultant, does not include $5 allocated to joint facilities - should be compared with $236 given in Table L-13, Appendix L, Coordinating Committee Report.

3 Not directly comparable to other alternatives because of run-of-river generation of approximately 113,000 megawatt hours per year.

It was concluded that several of the above sites are potentially feasible for pumped-storage development. The principal reason, however, for this investigation was to determine if there are alternatives for peaking power in the basin that would be more

economical than those associated with the Portage site.

The Portage pump-back and Mount Morris pumped-storage plans are included in Table IV-5 for comparison with pumped-storage sites located elsewhere in the basin. The cost estimates for the Portage power plans were made by the State's consultant with an interest rate during construction of six percent, instead of the 3¼ percent used by the Coordinating Committee. This was necessary in order to be consistent with the analyses made for the other pumped-storage sites. The Portage pump-back plan utilizes some run-of-river generation. Therefore, it requires less pumping energy per kilowatt of generation, and it cannot be compared directly with other alternatives on a cost per kilowatt basis.

Peaking Power Comparisons

Since the values in Table IV-5 cannot be compared directly, the alternative recommended by the Coordinating Committee (Portage pump-back development) with alternative peaking power facilities, further economic analyses were made. These compared the Committee's recommended alternative with conventional steam electric power and with the potential pumped-storage sites located in the State's investigation.

The Coordinating Committee's economic analysis is based on an interest rate for Federal projects of 3¼ percent for an amortization period of 100 years, and excluded consideration of taxes. In addition to an evaluation on the above basis, the State's economic analysis made an evaluation with an interest rate of six percent for 50 years. This latter evaluation allows a comparison with privately developed steam electric power and with other potential functional developments, such as municipal and industrial water supply and irrigation. The cost comparison includes consideration of the lesser amount of pumping energy required per kilowatt generation in the Portage pump-back development.

The results of the economic analyses are shown in Table IV-6. The relationship of costs between alternatives changes with interest rate and amortization period because the six percent rate, with a shorter amortization period, results in higher debt service costs on capital investment.

Table IV-6

ECONOMIC ANALYSIS OF POWER ALTERNATIVES

(Excluding Taxes)

Alternative	Annual Cost per Kilowatt	
	3½% Interest	6% Interest
Gas Turbine peaking power	$17.40	$19.30
Steam electric peaking power[1]	16.30	19.30
Portage conventional (Plan B - 150 MW)[2]	14.20	21.30
Portage pump-back (Plan C)[2]	14.20	20.80
Genesee Basin pumped-storage project	9.70	12.50

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1 Coordinating Committee used steam base-load plant in evaluating comparability ratio. Peaking steam would have lower capital and higher operating costs.

2 Portage costs are for power facilities only, not including any allocation of cost of dam and reservoir. Allocation of joint facilities annual cost to power in the Portage pump-back development is $0.18 per kilowatt (Table B-46, Appendix B)

The comparisons in Tables IV-5 and IV-6 indicate that hydroelectric development of peaking power at Portage is less economical than several pumped-storage alternatives. To avoid losing a potential resource, the installation of future power could be considered in Portage; particularly, if other uses justify the Project. However, it does not appear that any portion of the dam and reservoir costs could be allocated to power.

Effect of Portage on RG & E Plants

Four small conventional hydroelectric plants owned by the Rochester Gas and Electric Company are located on the Genesee downstream from Mount Morris. Three of these are located in the City of Rochester. The plants have small pondage and are basically used for generation of secondary energy with limitations on their available capability for peaking purposes. Regulation of Genesee River flows could enhance the value of these hydroelectric plants.

For the range of minimum flows considered in its studies, the Coordinating Committee estimated that the increase in average annual energy for these plants, due to regulation at Portage Reservoir, would provide annual benefits ranging from $10,000 to $60,000.

In the State consultant's studies, made prior to receipt of the Coordinating Committee's results, it was concluded that, the peaking capability at these plants could be increased by as much as 50 to 75 percent as a result of storage regulation, if all other water uses were foregone. On this basis, the benefits to these plants were estimated to be $215,000 per year for peaking capacity and $141,000 per year for energy generation.

If Genesee River natural flow and potential releases from reservoirs such as Portage were utilized for other purposes, this would result in flow reductions at RG & E plants to a minimum of 525 cfs from June through November and 1,000 cfs from December through May. Consequently, the estimated annual energy production would be reduced about 22,000 kilowatt hours. However, the present worth of losses to the RG & E plants could be considered negligible, since diversions for water supply (M&I) and irrigation would not reach their maximum until after 2000 which would be well past the useful life of the RG & E plants.

The results of studies by both the Coordinating Committee and the State's consultant indicate that the effect of Genesee River Reservoirs on the RG & E plants will be negligible.

Recreation

In the last 20 years the growth of water-oriented recreation in the United States has been phenomenal. Perhaps this can be most dramatically demonstrated by the increase in recreation attendance at Federally constructed reservoirs. Between 1946 and 1964, annual attendance at Corps of Engineers' reservoirs rose from 5 to 156 million; at TVA reservoirs, from 5 to 48 million; and at Bureau of Reclamation projects from less than 6.5 to over 24 million. This growth is indicative of the public's desire for water-oriented recreation. Moreover, projections indicate that this growth will continue at a rapid pace, although probably not at the meteoritic rate of the past 20 years.

The entire western region of the State is expected to generate an increasing demand for water-oriented recreation, especially because of the Buffalo and Rochester metropolitan areas. The magnitude of the recreation market is difficult to determine because it depends on many factors including socio-economic considerations and the number, size, location and quality of available resources. While it is generally agreed that the market is both large and growing, there is not agreement on its magnitude. However, water-oriented recreation developments appear to have a ready market, especially when located near urban centers.

Recreation is an important part of water resources planning and its economic value may constitute a significant amount of a project's benefits. The current Federal procedure of quantifying unit values per visitor-day represents one method of

analysis. Other procedures which generate recreation demand functions have been developed.

In its studies, the Coordinating Committee assumed that reservoir drawdown during the recreation season should not exceed 5 feet in any year of operation. Recreation benefits might be reduced significantly if the recreation pool were drawn below this level, however, it is not realistic to assume that such drawdowns are totally unallowable. A more flexible and equitable approach would be to accept more severe drawdowns in years of short supply. Recreators would incur infrequent deficiencies for a short period similar to that accepted in irrigation, low flow augmentation and hydroelectric power.

The above indicates a need for refinement of recreation criteria concerning reservoir drawdowns in order to develop better economic loss functions which can be used during project formulation. Before reservoir operating levels are established an evaluation of such effects on recreation would be made available to the public for their consideration.

Because of the time constraint the Coordinating Committee did not evaluate all realistic alternatives available for meeting water-oriented recreation demands. Some multipurpose reservoirs were investigated in considerable detail, but other recreation alternatives were not examined to comparable levels. The costs and benefits of all reasonable alternatives should be developed so that comparative economic appraisals can be made. Besides defining the economic efficiency of various choices, these appraisals would provide for the development of a recreation plan which would offer various types of recreational experiences.

The alternatives should include: development of other multipurpose reservoirs for recreation, public acquisition and development of recreation facilities at some of the existing inland lakes, development of small single-purpose recreation reservoirs, further utilization of the Great Lakes, and consideration of potential recreation reservoirs in nearby basins.

Much more should be known about the regional recreational market, especially its size and character. A special market research survey directed at regional residents would be helpful. This would establish the magnitude and make-up of the regional recreation market, and it would enable more intelligent planning of all recreation resources. A recreation market study at appropriate intervals should be made a part of the normal planning procedures.

Table IV-7

RECOMMENDED METHODS
FOR STREAM QUALITY CONTROL
GENESEE RIVER BASIN

Stream Sector Location	Recommended Alternative	Reservoir Name	Proposed Agency
Genesee River below Eastman Kodak Company	Effluent Transport		
Genesee River below Gates-Ogden-Chili STP	Low Flow Augmentation	Portage	CE
Genesee River below Avon	Low Flow Augmentation	Portage	CE
Oatka Creek below Warsaw LeRoy	Low Flow Augmentation Effluent Transport	18-12	SCS
Honeoye Creek below Honeoye Falls	Low Flow Augmentation	17-12	SCS
Wilkins Creek below Livonia	Low Flow Augmentation	16-7	SCS
Mill Creek below Wayland	Low Flow Augmentation	13-27	SCS
Silver Lake Outlet below Perry	Lake Outlet Regulation		

Table IV-8

IRRIGABILITY STANDARDS - GENESEE RIVER BASIN

Land Characteristics	LAND CLASSES 1	2	3	SPECIAL CROPPING 4S (Horticulture)	4F (Fruits)
Soils					
Texture	Sandy loam to friable clay	Loamy sand to friable clay	Loamy sand to permeable clay	Loamy sand to sandy loam	Loamy sand to loam
pH 1/	6.5 - 7.5	6.5 - 7.0	5.0 - 7.2	5.6 - 7.4	5.6 - 7.4
Depth to a) Sand	36"	24"	18"	36"	72"
b) Fragipan-bedrock	60"	48"	42"	60"	72"
Infiltration Rate (ins/hr)	0.8 - 2.5	0.3 - 0.8	0.2 - 0.3	2.0 - 3.0	0.5 - 2.0
Total Available Moisture	Not less than 3.5" of water for four feet	Same as Class 1	Same as Class 1	Not less than 2" for top two feet	Same as Class 1
Topography					
Slopes					
a) *Surface Irrigation*	Smooth slopes up to 2%	Smooth slopes up to 5% Rough slopes less than 2%	Smooth slopes up to 8% Complex slopes up to 4%		Up to 8%
b) Sprinkler	Less than 8%	Less than 8%	Less than 8%	Up to 3%	Up to 15%
Cover		Sufficient to reduce productivity	Requires costly but feasible clearing		
Removal					
Rocks 1/		Up to 50 cu. yds.	Up to 100 cu. yds.		Up to 50 cu. yds.
Trees		Cost comparable to rock removal	Cost comparable for rock removal		Cost comparable to rock removal
	Small amount of leveling and grading	Moderate grading	Heavy and expensive grading	Moderate grading	Small amount of leveling
Grading (cu. yds.) 1/	200 - 300	500 - 700	Up to 1000	-	200 - 300
Cost/acre 1/	$50 - 70	$125 - 150	Up to $200	$125 - 150	$50 - 70
Erosion Control	Needs ordinary management	Requires conservation practices	Special Conservation practices	Needs ordinary practice	Requires conservation management
Bench Terrace 2/					
0 - 5% slopes	0 - $42/acre	0 - $40/acre	0 - $40/acre	0 - $25/acre	0 - $40/acre
5 - 8% slopes	$40 - $80/acre	$40 - $80/acre	$40 - $80/acre		$40 - $140/acre
Drainage	No specific drainage	Some farm drainage	Significant farm drainage	Varies from no to significant farm drainage	Varies from no to significant farm drainage

Class 4 - Limited Arable includes lands having excessive deficiencies and restricted utility but which special economic and engineering studies have shown to be irrigable.
Class 5 - Non-Arable Severe limitations - includes lands which require additional economic and engineering studies to determine their irrigability and lands classified as temporarily unproductive pending construction of corrective works and drainage.
Class 6 - Non-Arable Lands which do not meet the minimum requirement of next higher class.

1/ Estimated -

2/ Range of Cost Estimates

Water Quality Management

At present the level of waste treatment in the Basin is inadequate to meet stream water quality standards. The most critical situation exists in the lower reaches of the Genesee in the Rochester area below the Eastman-Kodak outfall. Assuming that waste treatment levels of 90 percent reduction in BOD can be achieved by the year 1985, stream quality standards will still be contravened in many reaches of the Genesee during critical low flow periods. These areas and their recommended solution, based on the least costly alternative, are given in Table IV-7.

The Coordinating Committee concluded that a minimum release of 160 cfs from Portage would be adequate to meet the augmentation requirements below Avon and Gates-Chili-Ogden through 2020. Alternatively, it was concluded that an equivalent storage of 15,000 acre-feet in the Genesee River system would be adequate to meet these augmentation requirements in the lower reaches of the river. This compares to a total storage availability in Portage reservoir of 283,000 acre-feet.

Irrigation

Irrigated agriculture studies by the Coordinating Committee and the State can be categorized as follows:

a. Irrigable land resources.
b. Forecast crop production targets.
c. Irrigation development potentials.
d. Economic comparisons.

Irrigable Land Resources

The Soil Conservation Service (SCS) of the Department of Agriculture, classified the lands of the Genesee River and the Lake Ontario West Basins in terms of their suitability for supplemental irrigation. An investigation and field reconnaissance was made by the State's consultant using different land classification criteria. In particular, consideration was given to supplemental irrigation on lands having greater slopes than those considered suitable by the Soil Conservation Service.

The SCS criteria limits irrigation to lands having slopes of less than five percent or five feet in 100 feet. With suitable agricultural management, irrigation can be carried out on slopes of up to eight percent where general crops are grown. The land classification criteria used by the State's consultant are summarized in Table IV-8. These criteria, are to a high degree, based on those used by the Bureau of Reclamation (Department of the Interior).

The total acreage suitable for irrigation in the Genesee River Basin was determined by the SCS to be 49,600 acres. Using the criteria of the State's consultant, it was estimated that approximately 300,000 acres in the Genesee River Basin are irrigable. The distribution of these lands by elevation (Portage maximum conservation pool elevation - 1160) and by land classification is summarized in Table IV-9.

Table IV-9

GENESEE RIVER BASIN

LAND CLASSIFICATION SUMMARY

(Area in acres)

	Below El. 586'		Below El. 665'		Below El. 1,160'	
Class	Gross	Net	Gross	Net	Gross	Net
2	38,800	33,000	38,000	33,000	41,500	35,000
3	---	---	115,200	69,000	208,000	125,000
Subtotal	38,800	33,000	153,200	102,000	249,500	160,000
4	---	---	---	---	203,000	142,000
TOTAL	38,800	33,000	153,200	102,000	452,500	302,000

The SCS classified as irrigable a total of 183,000 acres of land in the Lake Ontario West Basin. The area considered was limited to the portion of the Basin north of the Barge Canal between Rochester and Lockport. The SCS classifications were reviewed and accepted, with a deduction of 10 percent for non-productive uses, to obtain a net irrigable area of 164,000 acres.

In summary, as much as 466,000 acres of land under the gravity command of the Portage Demonstration Project may be considered suitable for supplemental irrigation.

Forecasted Crop Production Targets

The Economic Research Service (ERS) (Department of Agriculture) carried out analyses of the crop production requirements of the Genesee River and the Lake Ontario West Basins and it projected the future acreage needed to meet these production requirements. A forecast of increased yields was included in the analysis. The forecasting methods used by the ERS projected the share of agriculture production of the study area in proportion to its present share of agricultural production in the nation. Adjustments are made in these methods for both

local and national trends and for conversion of land use from agriculture to urban and other purposes.

The actual growth of agricultural production in various regions of the country is primarily a matter of competitive economics, as determined by costs of production and of transportation in relation to market demands. Therefore, the food production goals as forecast by the ERS, did not in any manner imply a limit in the food production potentials of the area, nor do they establish an absolute minimum requirement for food production. With the increase in the use of processed foods, the potential for agricultural development is less limited by local market demands and more a function of the costs of production.

In the view of the State's consultant, ERS' projected non-irrigated yields of feed crops (corn, oats, hay) and wheat are higher than should be expected. Therefore, either a portion of such feed crops would have to be irrigated or additional acreages would be required to meet the projected feed requirements. Furthermore, feed crops can be irrigated cheaply on farms which have equipment for irrigating food crops. Accordingly, it was assumed by the State's consultant that some feed crops would be irrigated. On the basis of experiments carried out in western New York State, it was estimated that the annual yield increase for feed crops would be 1.5 percent (compounded) and that irrigation would increase this yield by 30 percent. It was assumed that the following proportions of farm product requirements would be irrigated in future years:

Year	Food Crops	Feed Crops
1970	25%	1%
1980	45	5
1990	75	10
2000	100	15
2010	100	20
2020	100	25

Table IV-10 presents the revised acreages required to meet the projected crop productions based on revised yields and the irrigation of some feed crops. This table also compares the Coordinating Committee's estimate of future irrigation acreage with the consultant's estimate.

Irrigation Development Potentials

The Coordinating Committee indicated that five SCS reservoirs in the Genesee River Basin can provide water to 2,780 acres, and 29 SCS reservoirs in the Lake Ontario West Basin can irrigate

Table IV-10

PROJECTED ACREAGE AND IRRIGATION REQUIREMENTS
TO MEET PROUDCT DEMANDS
(in Acres)

	1970	1980	1990	2000	2010	2020
Genesee River Basin						
Total Acreage						
Feed Crops & Wheat[1]	389,023	360,365	332,282	315,829	312,406	296,062
Non-Feed Crops	53,988	54,512	53,955	54,387	55,580	55,834
Acreage Irrigated						
Feed Crops & Wheat	2,530	12,020	22,225	31,750	41,940	49,965
Non-Feed Crops	7,990	13,960	22,920	30,610	30,825	30,315
Lake Ontario West Basin						
Total Acreage						
Feed Crops & Wheat[1]	202,500	184,100	175,600	171,000	167,800	162,700
Non-Feed Crops	60,100	56,400	53,000	51,200	49,100	47,600
Acreage Irrigated						
Feed Crops & Wheat	1,310	5,950	11,480	16,815	21,760	26,050
Non-Feed Crops	13,450	24,850	35,025	44,900	42,800	41,300
Total Genesee River & Lake Ontario West Basin Irrigated Acreage Requirements						
State Consultant's Estimate	25,280	56,780	91,650	124,075	137,325	147,630
Coordinating Committee's Estimate	---	27,860	55,650	56,360	57,080	57,570

1 ERS acreage estimates adjusted to reflect changes made in estimated feed crop yields.

12,980 acres (see Plate 3). Because some of the land in SCS project areas in the Genesee River Basin is already being irrigated, total land that could be irrigated would amount to 7,500 acres. In the Lake Ontario West Basin, including present irrigation, 18,000 acres of land could be irrigated to satisfy the projected requirements. The Coordinating Committee indicated that development of all SCS projects would leave a deficit in 2020. This would amount to 22,400 acres that could be irrigated in the Genesee River Basin and 9,700 acres in the Lake Ontario West Basin. The Coordinating Committee recommended using SCS projects for providing irrigation. However, alternative sources such as larger reservoirs, Lake Ontario or groundwater were not investigated in any detail.

Since major reservoirs and groundwater offer a significant potential for irrigation supply, the State investigated their potentials for supplying irrigation water. This included an analysis of the costs and benefits for alternatives.

The costs of delivery of water to the farm and on-farm costs of supplemental irrigation were estimated for various agricultural areas, considering three different sources of water supply: Portage Reservoir, groundwater and Lake Ontario. These costs are summarized in Table IV-11. This table includes annual costs for water conveyance and pumping systems, on-farm irrigation and drainage systems, and the allocated cost of Portage Reservoir storage. SCS calculations of project costs did not include on-farm costs. Table IV-11 presents on-farm costs which were calculated in connection with Barge Canal irrigation investigations.

Table IV-11 shows that in the Genesee River Basin where groundwater is an alternative, it would be more economical than Portage Reservoir. Also, Table IV-11 indicates that it would be more economical to use water from the Genesee, delivered by the Barge Canal, for irrigation in the Lake Ontario Basin, than in the Genesee River Basin. This is true not only because of lower costs, but also because of higher benefits. Table IV-11 indicates that, in any event, irrigation of Area 1 (see Plate 3) of the Genesee River Basin by water from larger reservoirs such as Portage would not be economical.

Groundwater, as a source for irrigation water, can be developed individually on each farm without the requirement for legislation or formulation of administrative bodies. However, centralized development of large quantities of groundwater will require implementing measures. The Coordinating Committee investigations identified potential aquifers and estimated probable yields from individual wells. However, the potential sustained yields of the aquifers were not determined. The State will not encourage the development of groundwater for irrigation unless additional investigations are made to confirm the assumed values of long-term yields.

Table IV-11

COST COMPARISON OF IRRIGATION WATER SOURCES

(Not including storage costs)

	Genesee River Projects				Lake Ontario West Basin Projects[2]				
	Area 1	Area 2	Area 3	SCS Projects	Area 1	Area 2	Area 3	Other Areas along Barge Canal	SCS Projects
Principal land class	4	2	2	r.d.[1]	r.d.[1]	r.d.[1]	r.d.[1]	r.d.[1]	r.d.[1]
Net irrigable area-acres	22,400	16,400	10,100	2,780	24,500	9,100	30,800	100,000+	12,980
Annual benefits ($/acre)	34.65	55.08	55.08	62.00	64.50	64.50	64.50	64.50	50.00
Annual Cost of Irrigation System ($/acre)[3]									
Water Source									
From Portage[4] (Benefit/Cost Ratio)	49.80 (0.70)	45.80 (1.20)	43.20 (1.28)	-	-	-	-	40.00[2] (1.61)	-
From Ground Water (Benefit/Cost Ratio)	None	41.80 (1.32)	41.80 (1.32)	-	None	None	None	None	-
From Lake Ontario (Benefit/Cost Ratio)	-	-	-	-	47.60 (1.35)	50.40 (1.28)	48.20 (1.34)	-	-
From small streams (Benefit/Cost Ratio)	-	-	-	50.00[5] (1.24)	-	-	-	-	46.50[5]

1/ Random drainage as classified by SCS.

2/ Using Barge Canal water replaced by Portage.

3/ Costs based on 6% - 50 years.

4/ Including $2.00/acre allocated annual cost of Portage Reservoir storage (Based on irrigation of 24,000 acres along Barge Canal)

5/ Costs shown are average for 5 projects in Genesee and 29 projects in Lake Ontario West. Estimated on-farm costs of $28.00/acre (based on Barge Canal irrigation)

Some preliminary investigations were made to determine the capacity of the Barge Canal to convey water to the Lake Ontario West Basin. During the navigation season, the present diversion at the head of the Barge Canal at Lockport is 1150 cfs and delivery to the Genesee River crossing upstream of Rochester is 800 cfs. Between these two points, diversions are made for hydroelectric power generation at Medina (225 cfs) and for irrigation and other uses. Storage releases from Genesee River reservoirs such as Portage could replace the reductions in Barge Canal flow caused by the diversions between Lockport and Rochester. These releases would provide the necessary flow to maintain adequate depths for navigation between Medina and Rochester. Ignoring possible legal constraints, the investigations indicated that an additional 300 cfs could be diverted from the canal for irrigation without being detrimental to navigation. Also, the minimum water level at the Genesee River crossing of the Barge Canal would have to be raised about 0.3 feet. This would reduce by half the 0.6 foot fluctuation in stage allowed to the Rochester Gas and Electric Company. Winter is the peak load season, therefore, peaking capacity reduction at these plants in the summer irrigation season would represent only a minor loss in value.

In addition to the 300 cfs that could be replaced by reservoir releases, such as those from Portage, canal flows which are presently diverted at Medina for hydroelectric power generation may, in the future, be available for irrigation. These low-head hydroelectric plants, may become uneconomical. This would provide an additional 225 cfs for irrigation or other uses. It was estimated that the 225 cfs diverted at Medina has an annual value of about $35,000 for electric power generation. Capacity value at these plants was considered negligible since they are not available in the winter, peak load season. If used during the summer for irrgiation of 18,000 acres along the Barge Canal, the 225 cfs would have an annual benefit of about $480,000. The prospect of an over ten-fold increase in the value of this water if converted from power to irrigation suggests the desirability of re-evaluation of diversion allocations, particularly during the summer irrigation months of July and August. This conversion may require only minimal administrative adjustment and change in practices since it might be an extension of the present use of Barge Canal water for irrigation.

Using the total of 525 cfs as being available for irrigation and the computed peak period requirement of one cfs per eighty acres, a total of 42,000 acres in the Lake Ontario West Basin could be irrigated from the Barge Canal without storage regulation of canal diversions. Replacement water from reservoirs such as Portage would be needed to irrigate 24,000 acres of this total. Reregulating storage which might be provided near the canal would allow for irrigation of substantially more acres and this prospect should be

investigated in detailed project studies. The maximum flow that could be transferred from Genesee River Reservoirs to the Barge Canal due to the canal's restrictions is estimated at 300 cfs. The average which could be irrigated by gravity from reservoirs at or above the Portage site total 50,500 acres. Of this amount, 26,500 acres are in areas of the Genesee Basin which have groundwater as a potential source of supply. The remaining portion of the Genesee Basin (Area 1) is shown to be uneconomical for irrigation (Table IV-11). Thus, if the groundwater potential in Areas 2 and 3 is confirmed, Genesee River Reservoir water would be economically usable for only 24,000 acres in the Lake Ontario West Basin, unless reregulating storage could be developed along the Barge Canal to permit water deliveries to be stored for use during peak requirement periods.

The estimates of irrigation benefits presented in Table IV-11 are based on a project-type analysis using production costs and returns computed by the Economic Research Service for various crops. However, the SCS and the State's consultant differed in their use of the ERS data to compute irrigation beneftis.

The SCS assumed that only 30 percent of a project area would be irrigated and that this area would be 100 percent potatoes and vegetables with and without the project. Reports by the SCS and the ERS state that some fruits will probably be irrigated by the year 2000 and that some low value (feed) crops may be irrigated due to availability of equipment and water, but the Coordinating Committee's cost and benefit estimates did not include these items.

The State's consultant assumed that with installation of a project-type irrigation system, all potatoes, vegetables, fruits, corn, grain, hay and wheat in the project area would be irrigated. Percentages of fruits and vegetables were estimated for the net irrigable area with and without the project based on proportions of land suitable for these crops. The remaining net irrigable area, being of lower quality lands was assumed to be used for irrigated feeds and grains. It was assumed that with project water available, a higher percentage of the area would go into vegetables than under dry farming, thereby giving some credit to change in land use. However, for the comparison, it was assumed that, even under dry farming, the proportion of land in vegetables would increase somewhat in the future.

The State's consultant felt that the approach taken by the Coordinating Committee was applicable only in the small areas (100 to 1000 acres) to which it was applied. In this case, with the small reser-

voirs involved, water may be delivered to only a few specialized vegetable farmers. In a project type analysis where 10 to 30 thousand acres are put under an irrigation system this is not considered to be true. Many general crop farmers would change part of their acreage into high value crops once water became available. Since equipment and water would be available, this farmer would irrigate both his high and low value crops if the increased return would more than pay for his extra labor and water cost. Preliminary analyses indicate that the increased return per acre of feed crops would average about $13/acre while the incremental cost of labor would be about $8/acre.

The computation of net benefits per acre to irrigation using the two approaches resulted in values which are nearly equal. This is because the State's consultant includes both the change in land use and the irrigation of feeds and grains. The change in land use tends to increase the net benefit per acre over the Coordinating Committee's approach of 100 percent vegetables with and without irrigation while the irrigation of feeds and grains tends to decrease this benefit. Although the net benefit per acre would be nearly equal using either of the two approaches, the total water requirement for the project area would not be equal because the Coordinating Committee assumed only 30 percent of the net area irrigated while the State's consultant assumed 100 percent.

The State's consultant does not believe it is realistic in planning the basin's future water needs, to assume only 30 percent of an area will be irrigated once an irrigation project is installed. If irrigation of 100 percent of the net project areas is assumed in planning the project, water will be available if the farmers decide to change entirely to high value crops or if they decide to irrigate some low value crops.

Preliminary analyses indicate that the following combination of project potentials (Table IV-12) gives promise of being an economic means of adequately meeting the projected need for irrigated acreage.

Table IV-12

IRRIGATION PROJECT POTENTIALS

GENESEE RIVER BASIN AND LAKE ONTARIO WEST BASIN

Irrigated Area Required to Meet Projected Needs in 2020[1]	147,630 acres
Area Presently Irrigated	10,700
Projects Available to Meet Needs	
Portage Demonstration Reservoir Project (Barge Canal)[2]	24,000
Ground Water (Areas 2 & 3), Genesee Basin	26,500
SCS Projects	12,980
Lake Ontario	64,400
Barge Canal (Medina Releases), Lake Ontario West Basin	18,000
Total Area Available to Meet Project Needs	156,580

1 From Table IV-10
2 Other Genesee River Reservoirs are possibilities

Municipal and Industrial Water Supply

Municipal and industrial water supply systems in the Genesee River Basin obtain water from Lake Ontario, inland lakes and groundwater. Both municipal and industrial water requirements are heavily concentrated in the Rochester metropolitan area. Present municipal water supply to the Rochester metropolitan area is approximately 78 mgd, about 90 percent of the Basin's total use. Industrial water requirements are concentrated in the Rochester area, with over 50 percent of the estimated present requirement (48 mgd) used by the Eastman Kodak Company.

In general, the municipal and industrial water supply systems outside the Rochester metropolitan area are small. It was assumed that these areas can meet most of their needs for the next 50 years by expansion of present sources. These sources are generally existing lakes in the central part of the basin and groundwater in the southern part. However, detailed planning of the Basin's water resource development should include evaluations of the adequacy of their present and potential sources. The City of Rochester system presently receives 28 mgd of its total requirement from Lakes Hemlock and Canadice, with the remainder from Lake Ontario. The Monroe County Water Authority, which serves the urban area outside Rochester, presently obtains virtually all of its water from Lake Ontario, with a small amount purchased for the City to serve upland areas of the County. The Authority's present long-range plans are for increased use of the Lake Ontario source. However, they have expressed a definite interest in the potential of upland supplies and would probably revise their plans if upland supplies proved to be more economical.

Although Lake Ontario presents an unlimited source of water for the Rochester metropolitan area, the water must be pumped to the service areas. Also, some operational problems are encountered due to wind and temperature changes affecting coagulation. The minimum static pump lift in the southern part of Monroe County service area is about 300 feet. Therefore, substantial economic advantages may exist if water from the Genesee River could be introduced into the system at a higher elevation. The potential storage in Genesee River reservoirs is more than adequate to meet the water needs of the Rochester metropolitan area in the year 2020. Also, data on water quality indicate that the quality of Genesee River water is comparable to that of Lake Ontario. Therefore, their differences in treatment costs would be negligible.

The Coordinating Committee study assumed that the Rochester metropolitan area would continue to develop Lake Ontario as a municipal and industrial water supply source. For comparison purposes, this State supplement contains cost estimates for both the Genesee River and Lake Ontario as alternative sources of water supply. It was assumed, for both alternatives, that construction of treatment and distribution facilities would be staged at 10-year intervals between 1980 to 2020. The analysis indicates that the most economical Genesee River development would be to have an intake and treatment plant at a point near the Barge Canal crossing. A general layout and cost estimate was made for the enlargement and construction of mains to transmit water from the Genesee intake to the existing distribution system.

Table IV-13

COMPARISON OF ALTERNATIVE MUNICIPAL AND INDUSTRIAL WATER SUPPLY SOURCES

GENESEE RIVER - LAKE ONTARIO

(Average annual costs in 1000 dollars)

	1980 1990	1990 2000	2000 2010	2010 2020	Average
Lake Ontario					
Investment Costs[1]	1,045	2,034	3,131	4,071	
Operating Costs[2]	351	655	982	1,276	
Power Charges	790	1,019	1,218	1,484	
Total Annual Cost	2,186	3,708	5,331	6,831	4,514
Genesee River					
Investment Costs	943	1,818	2,691	3,466	
Allocated Portage Cost[3]	261	475	728	920	
Operating Costs[2]	326	607	886	1,135	
Power Charges	446	442	534	626	
Total Annual Cost	1,976	3,342	4,839	6,147	4,078
Annual Cost Difference	210	366	492	684	436

1 4% over 50 years
2 Exclusive of power charges
3 3½% over 50 years proportioned to water delivery

Table IV-14

MUNICIPAL AND INDUSTRIAL WATER FINANCIAL ANALYSIS
(costs in 1,000 dollars)

Year	First Cost	Interest During Const.	Investment Cost	Operation and Maintenance Alloc.	Operation and Maintenance Specif.	Pumping Energy	Investment Alloc.[1]	Investment Specif.[2]	Total Average Annual	Total for period
1980	23,050[3]	749	23,799	28	326	446	223	1523	2546	25,460
	14,420[4]	936	15,356							
1990	17,900[3]	-	17,900	28	607	442	447	2669	4193	41,930
2000	17,900[3]	-	17,900	28	886	534	700	3815	5963	29,815
2005				28	886	534	700	2292	4440	22,200
2010	16,390[3]	-	16,390	28	1135	626	892	3341	6022	30,110
2015				28	1135	626	892	2195	4876	24,380
2020				28	1135	626	892	2195	4876	24,380
2025				28	1135	626	892	1049	3730	18,650
2030				28	1135	626	-	1049	2838	14,190
2035										
								55 year Total		231,115
								Average Annual for 55 year Periods		4,200

1/ Portage repayment over 50 year period at 3 ⅛% interest, staged in proportion to water delivery.

2/ M & I Facilities repayment over 25 year period at 4% interest.

3/ Intake, treatment, and distribution facilities.

4/ Allocated cost of Portage Reservoir - Table IV-2.

A comparison of annual costs of the alternative systems is presented in Table IV-13. This preliminary estimate indicates that without considering reservoir costs the average annual costs for the Genesee River source could be about $1,000,000 less than water from Lake Ontario primarily attributable to power savings. However, using the allocated cost of M & I water for the Portage Demonstration Project as presented in the table the average annual cost of the Genesee River source would be about $436,000 cheaper. A sample financial analysis for the Genesee River Source is shown in Table IV-14. This analysis is based on the use of 4 percent - 25 year maturity bonds for investments in intake, treatment and distribution facilities. It was assumed that the allocated investment cost of $14,420,000 for the Portage Demonstration Reservoir would be paid over 50 years at 3¼ percent interest. The payments were roughly proportioned to the delivery of water so that initial payments would be smaller than final payments.

The water requirements are based on estimates made by consultants retained by the Monroe County Water Authority. The average water requirements of the City of Rochester and the MCWA are forecasted to be 132 mgd in 1980 rising to 275 mgd in 2020. Corresponding peak day capacity requirement forecasts are 230 mgd and 490 mgd. Volumes of water which would be required from the Genesee River are summarized in Table IV-15.

Table IV-15

ESTIMATED MUNICIPAL WATER REQUIREMENTS THAT COULD BE MET FROM GENESEE RIVER

(In acre-feet per month)

Year	1980	2000	2020
January 1-April 30	5,900	10,700	15,900
May 1-August 31	12,300	20,700	26,300
September 1-December 21	8,200	14,400	20,900
Average Year-acre-feet per month	8,800	15,300	21,100
Acre-feet per year	105,600	183,200	252,400

Reservoir Operation Analysis

The Coordinating Committee assumed that the Portage Reservoir draw-downs for M & I water supply and irrigation would be too detrimental to recreation. Therefore, their formulation of the Portage Project primarily considered power, recreation and water quality management.

New York State conducted additional reservoir operation studies for Portage. These computer studies, using the 57-year historical flow record on the Genesee River, encompassed a range of releases for withdrawal-type uses both with and without pump-back power at Portage. The range studied represents the combinations of uses discussed in this chapter.

Water from Portage via the Barge Canal could be used initially to irrigate 24,000 acres in the Lake Ontario West Basin and, depending on the availability of groundwater, another 26,500 acres in Genesee Basin Areas 2 and 3. Alternatively, water from Genesee River reservoirs might irrigate additional land in the Lake Ontario West Basin, if reregulating storage is provided along the Barge Canal. An allowance of 26,000 acres was included in the studies to represent this possibility. Future levels of incremental municipal and industrial water requirements for the Rochester metropolitan area are shown in Table IV-15. For the reservoir operation studies, it was assumed that the minimum summer flow of the Genesee at Rochester would be maintained at 525 cfs (375 from the Barge Canal, 50 cfs from Rushford Lake and 100 cfs from the Genesee River).

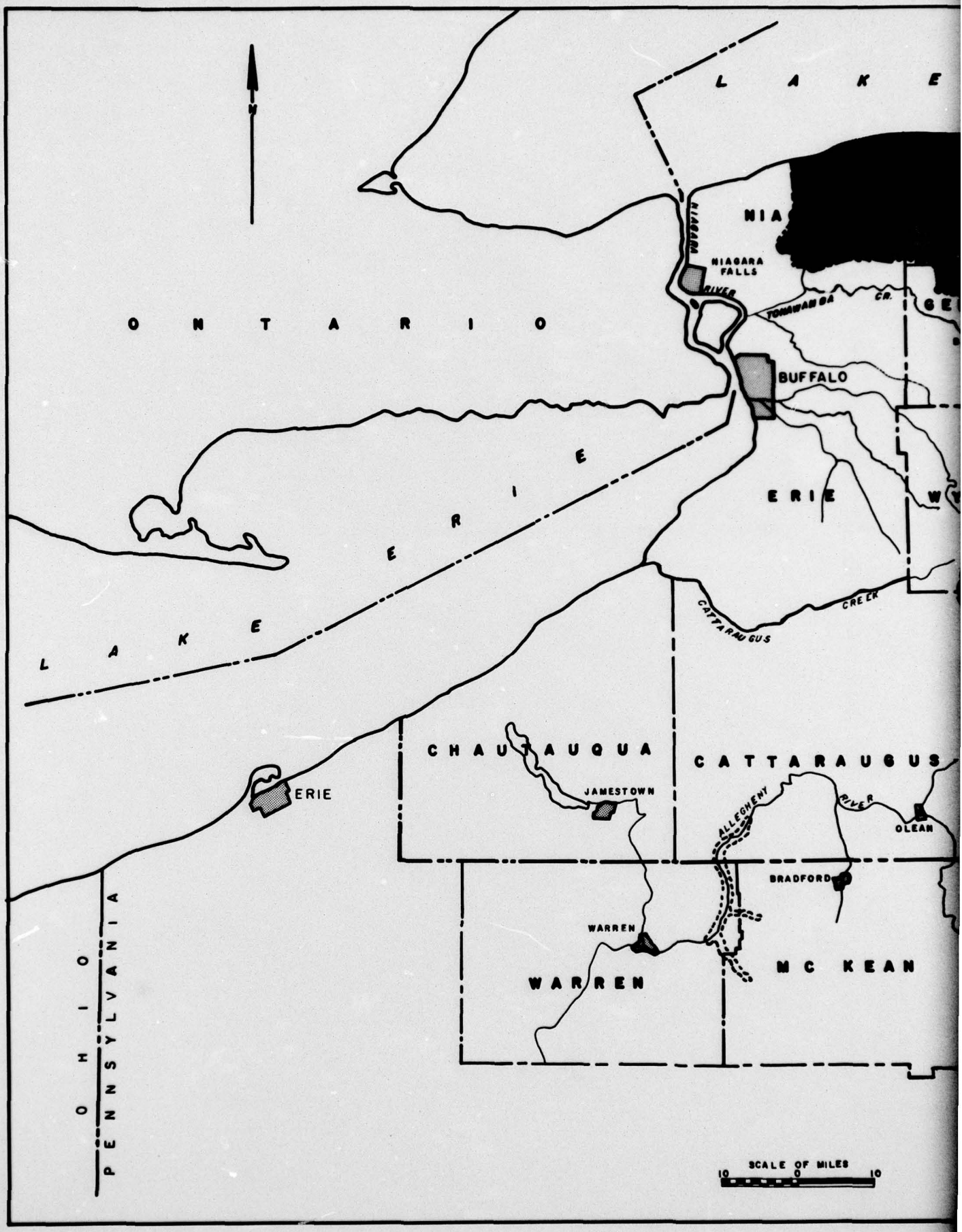
Maximum drawdowns of Portage Reservoir at the end of the recreation season, September 1, for various combination of releases and frequencies are shown in Table IV-16 and Plates 5 and 6.

Table IV-16

PORTAGE RESERVOIR[3] DRAWDOWNS

Reservoir Uses	Maximum Drawdown (feet) at September 1 in Indicated Percent of Years				
	1%	5%	10%	20%	50%
M&I Water, Irrigation, Recreation, Low-Flow Augmentation[1]					
Irrigation - 24,000 acres) M & I Water for 1980)	11.0	8.0	6.0	4.0	0.5
Irrigation - 24,000 acres) M & I Water for 1990)	15.0	11.0	8.5	6.0	2.0
Irrigation - 24,000 acres) M & I Water for 2000)	18.5	14.0	12.0	9.0	4.0
Irrigation - 24,000 acres) M & I Water for 2020)	24.0	17.0	14.5	11.5	6.0
Irrigation - 50,000 acres) M & I Water for 1980[4])	18.5	13.5	10.5	7.5	1.0
M&I Water, Power, Recreation, Low-Flow Augmentation[2]					
M & I Water for 1980	10.0	5.5	3.5	2.0	0.0
M & I Water for 1990	15.5	10.0	7.0	4.0	0.5
M & I Water for 2000	22.5	15.0	11.5	7.5	2.0
M & I Water for 2020	36.0	21.5	14.5	10.0	4.5

1 Top of conservation pool at elev. 1190 feet
2 Top of conservation pool at elev. 1160 feet
3 Top of sediment pool at elev. 1130 feet. Each run includes 60 cfs release from Portage for low-flow augmentation, 40 cfs contributed from downstream drainage area for total of 100 cfs at Rochester.
4 The maximum drawdown for this set of values is at October 1.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NIAGARA RIVER
TONAWANDA CR.
O N T A R I O
BUFFALO
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CATTARAUGUS CREEK
CHAUTAUQUA
CATTARAUGUS
JAMESTOWN
ALLEGHENY RIVER
OLEAN
ERIE
BRADFORD
WARREN
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MC KEAN
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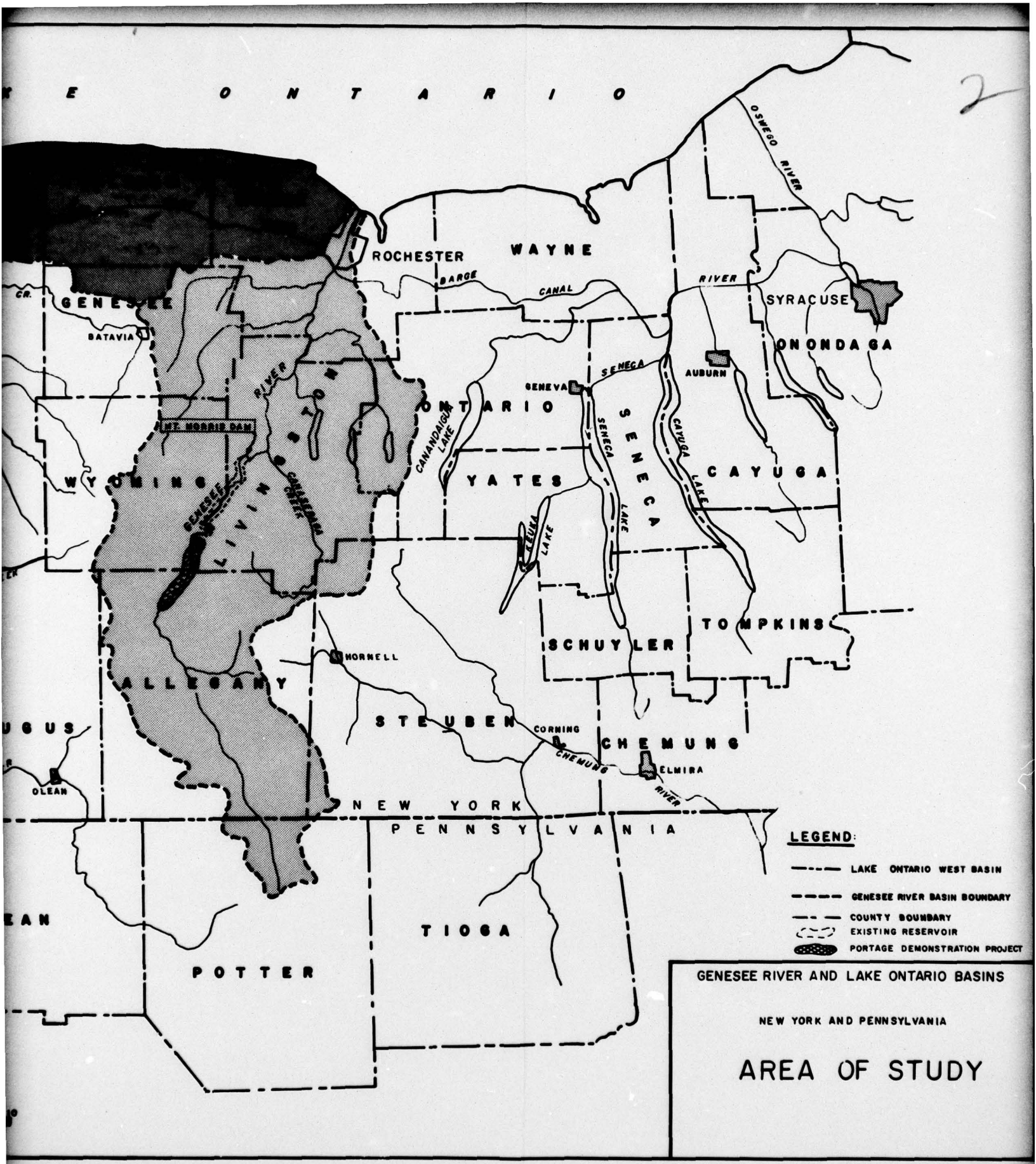
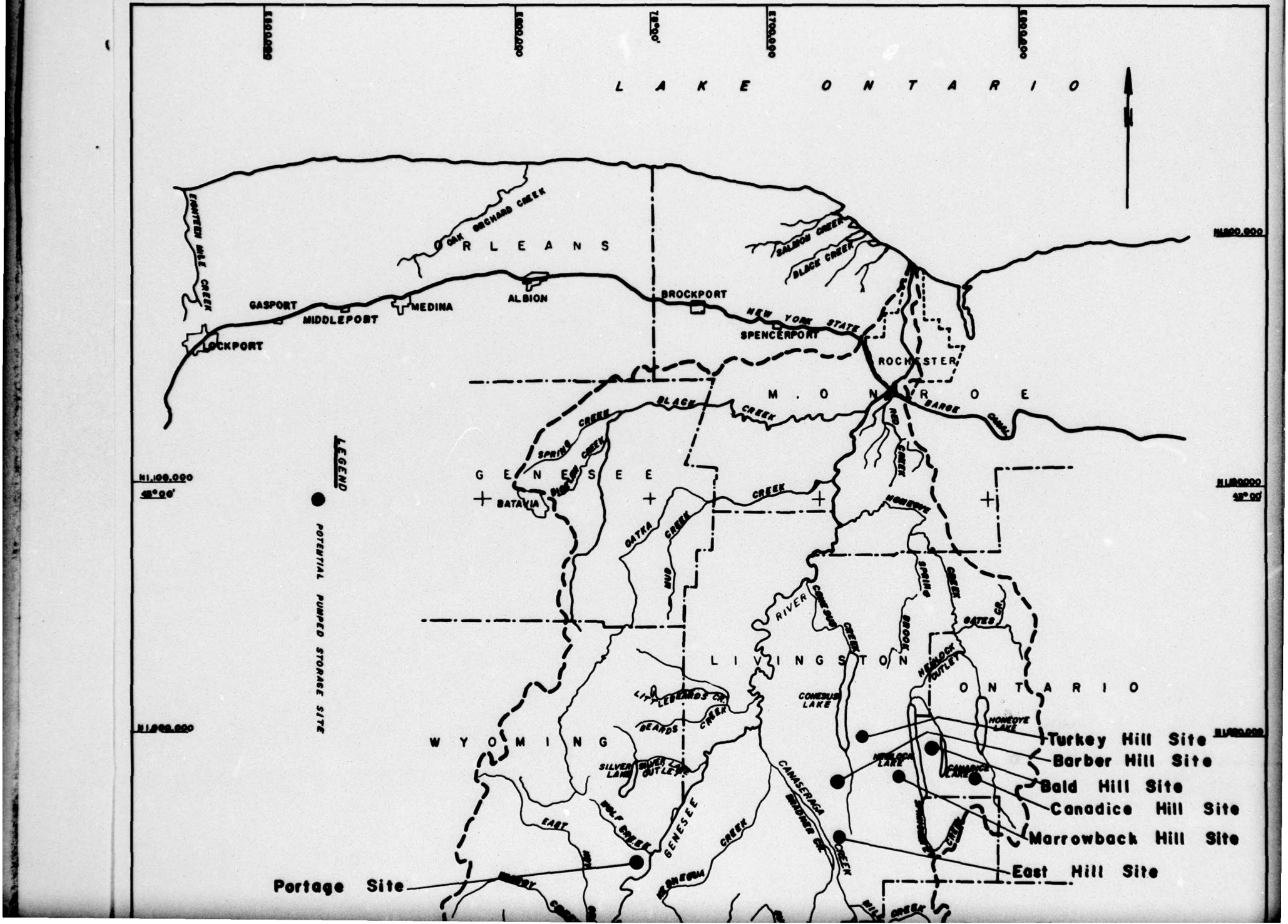


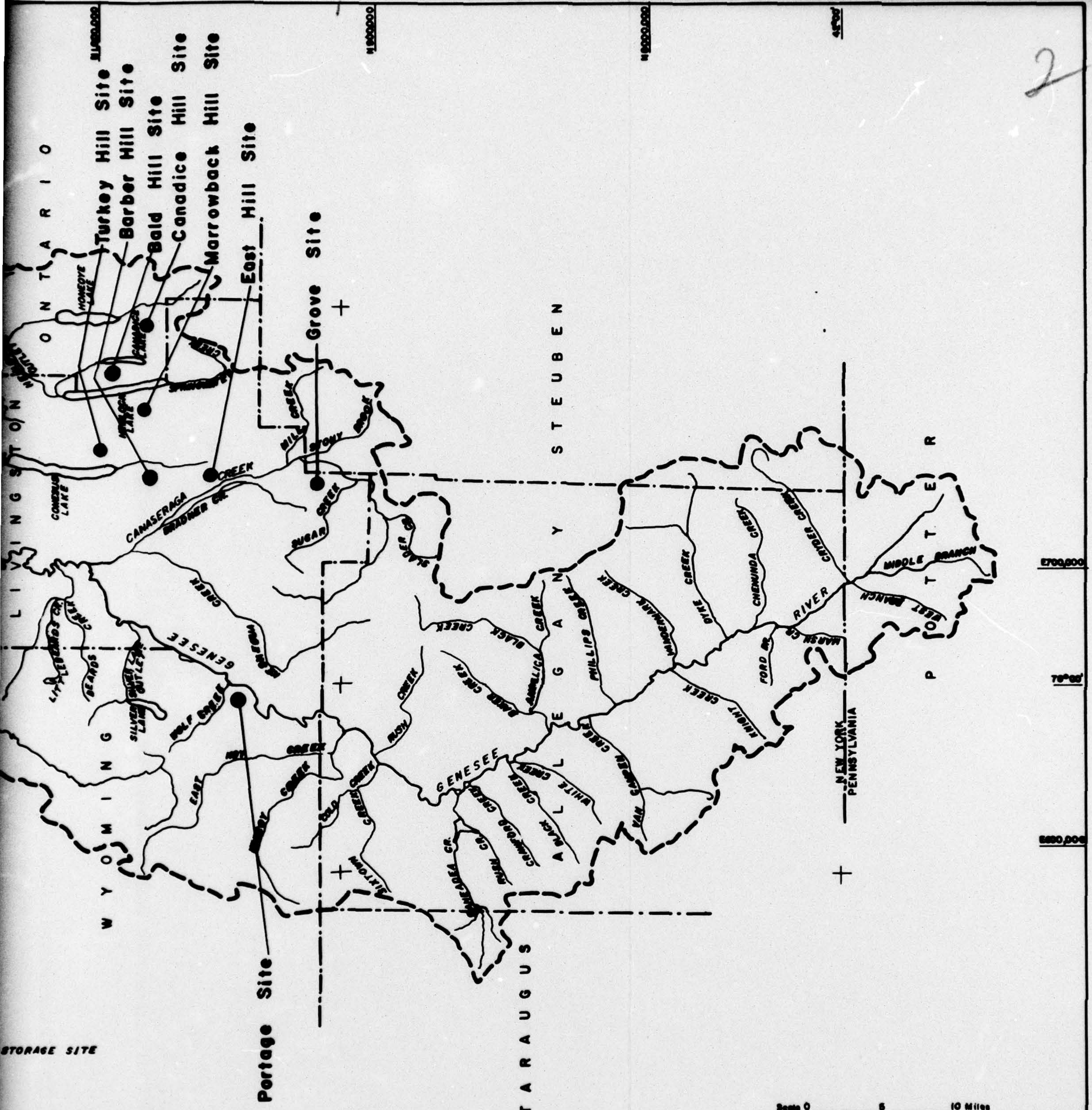
GENESEE RIVER AND LAKE ONTARIO BASINS

NEW YORK AND PENNSYLVANIA

AREA OF STUDY

PLATE 1

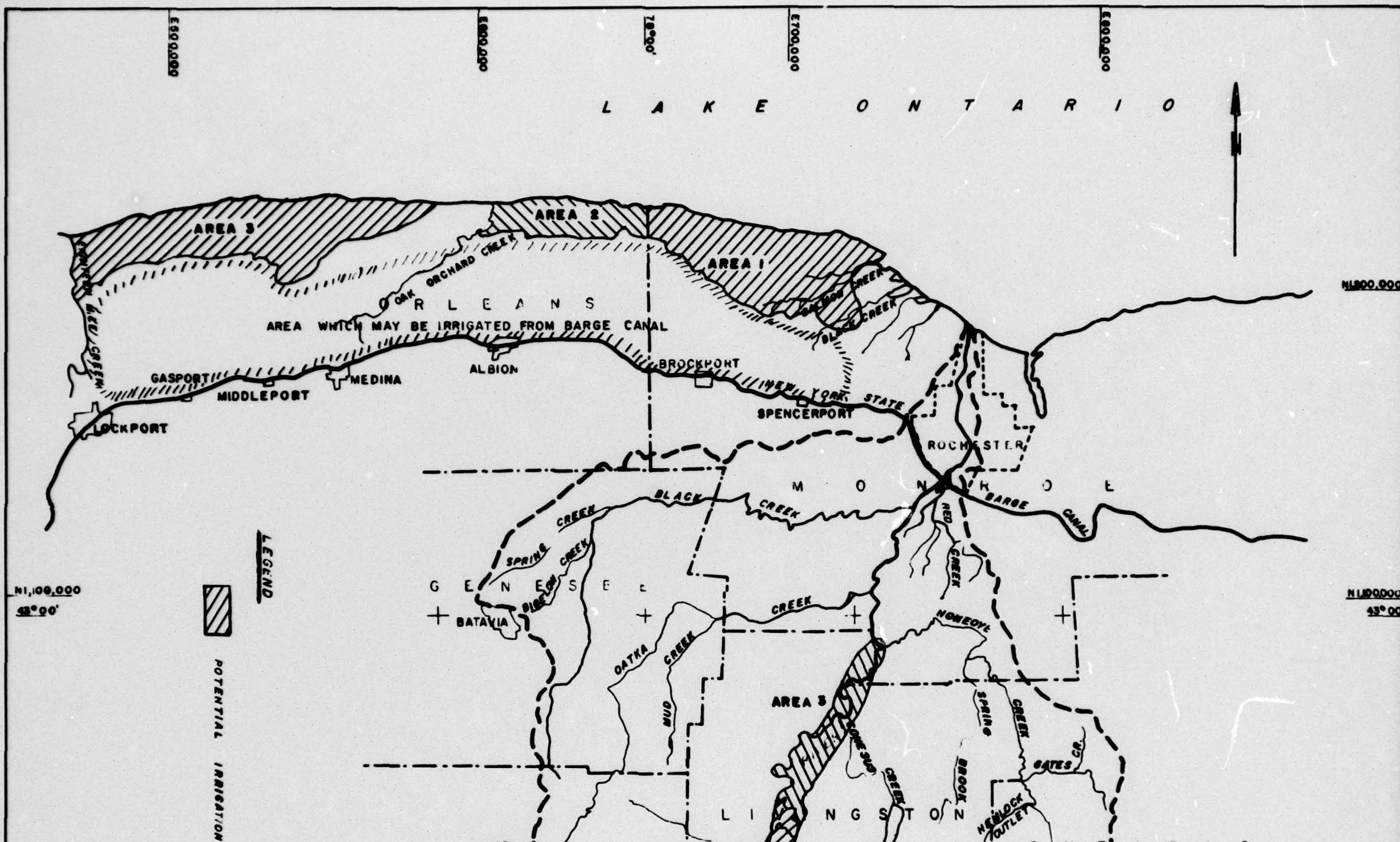

LAKE ONTARIO
ORLEANS
GENESEE
MONROE
LIVINGSTON
WYOMING
ONTARIO
EIGHTEEN MILE CREEK
OAK ORCHARD CREEK
SALMON CREEK
BLACK CREEK
GASPORT
MIDDLEPORT
MEDINA
ALBION
BROCKPORT
NEW YORK STATE
SPENCERPORT
ROCKSTER
LOCKPORT
BARGE CANAL
SPRING CREEK
PUMP CREEK
BATAVIA
OATKA CREEK
SPRING CREEK
GATES CR.
CONESUS LAKE
HONEOYE LAKE
HONEOYE CREEK
CANADICE LAKE
SILVER LAKE
SILVER LAKE OUTLET
BEARDS CREEK
LITTLE BEARDS CR.
EAST
GENESEE
CANASERAGA CREEK
BARDNER CR.
LEGEND
POTENTIAL PUMPED STORAGE SITE
Turkey Hill Site
Barber Hill Site
Bald Hill Site
Canadice Hill Site
Marrowback Hill Site
East Hill Site
Portage Site



GENESEE RIVER AND LAKE ONTARIO BASINS

ALTERNATIVE PUMPED STORAGE SITES

PLATE 2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E600,000
78°00'
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LAKE ONTARIO
N
AREA 3
AREA 2
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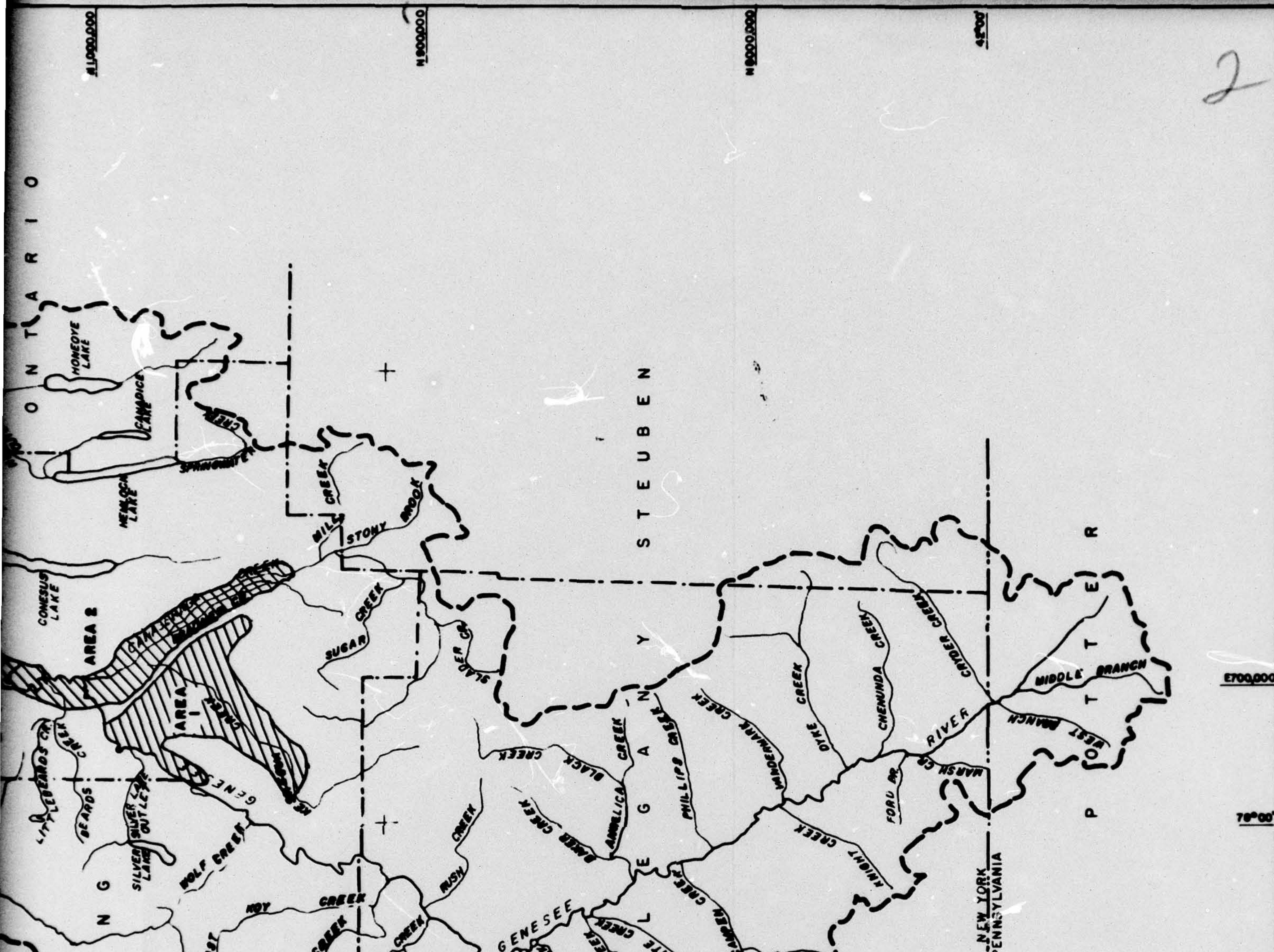
ORLEANS
AREA WHICH MAY BE IRRIGATED FROM BARGE CANAL
OAK ORCHARD CREEK
BLACK CREEK
LOCKPORT
GASPORT
MIDDLEPORT
MEDINA
ALBION
BROCKPORT
NEW YORK STATE
SPENCERPORT
ROCHESTER
MONROE
BARGE CANAL
BLACK CREEK
RED CREEK
SPRING CREEK
GENESEE
BATAVIA
OATKA CREEK
MUD CREEK
HONEOYE CREEK
SPRING BROOK
GATES CR.
HEMLOCK OUTLET
LIVINGSTON
CONESUS CREEK
CONESUS LAKE
ONTARIO
HONEOYE LAKE
HEMLOCK LAKE
CANADICE LAKE
SPRINGWATER CREEK
LITTLE BEARDS CR.
BEARDS CREEK
SILVER LAKE
SILVER LAKE OUTLET
WYOMING
WOLF CREEK
EAST
GENESEE
AREA 2
AREA 1
CREEK
MILL CREEK
LEGEND
POTENTIAL IRRIGATION PROJECT AREAS

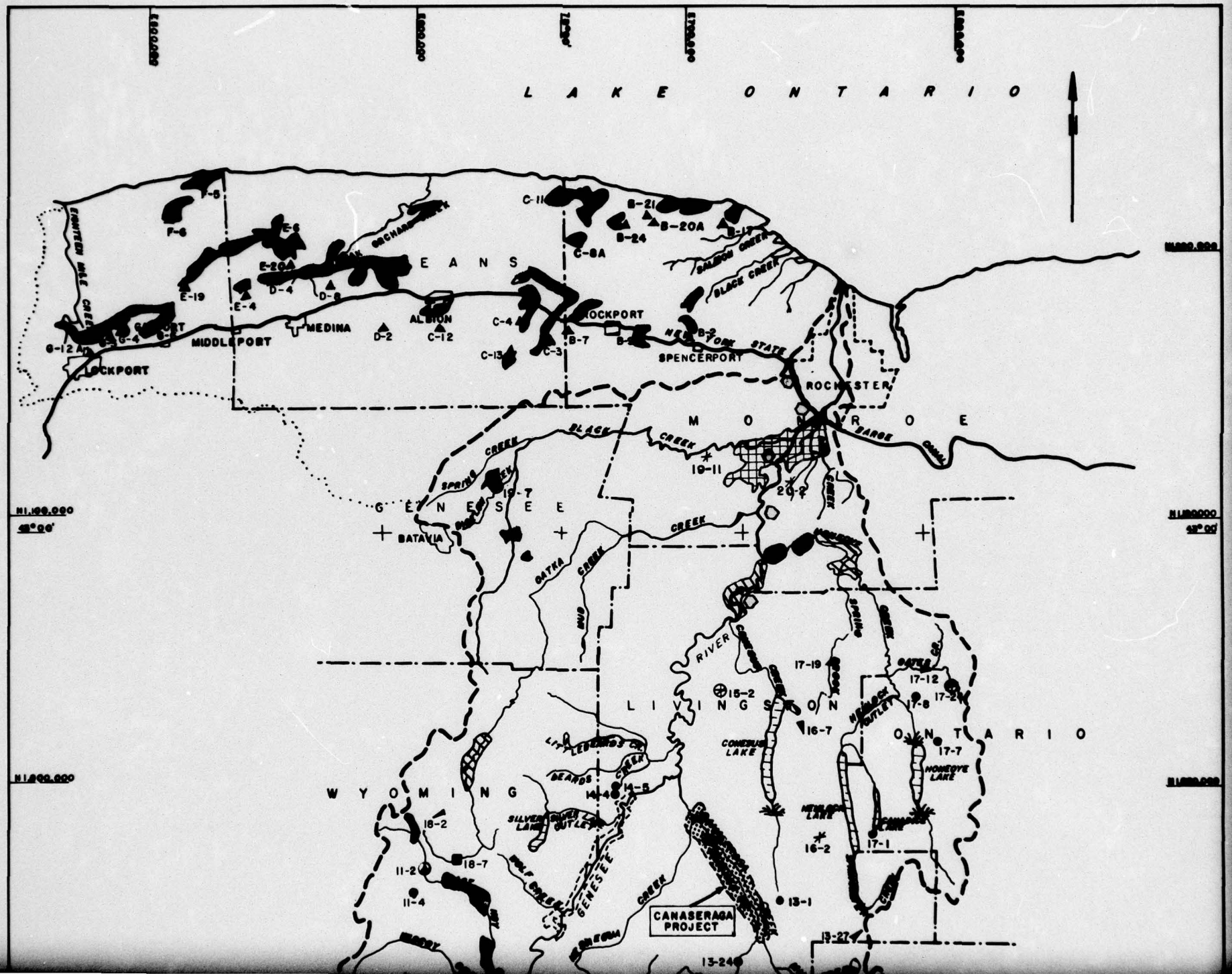


GENESEE RIVER AND LAKE ONTARIO BASINS

POTENTIAL IRRIGATION PROJECTS

PLATE 3

2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ROCKPORT
SPENCERPORT
ROCHESTER
BATAVIA
CANASERAGA PROJECT
BLACK CREEK
SPRING CREEK
OATKA CREEK
MID CREEK
RIVER
CONESUS LAKE
HONEOYE LAKE
NEWLAND LAKE
SILVER LAKE
BEARDS CREEK
LITTLE LEBANON CR.
GENESEE
BARGE CANAL
E-5
F-5
F-6
E-20A
E-19
E-4
D-4
D-8
C-11
B-21
B-20A
B-24
C-8A
B-12
B-2
C-4
C-12
C-13
C-3
B-7
B-6
D-2
E-12A
19-11
20-2
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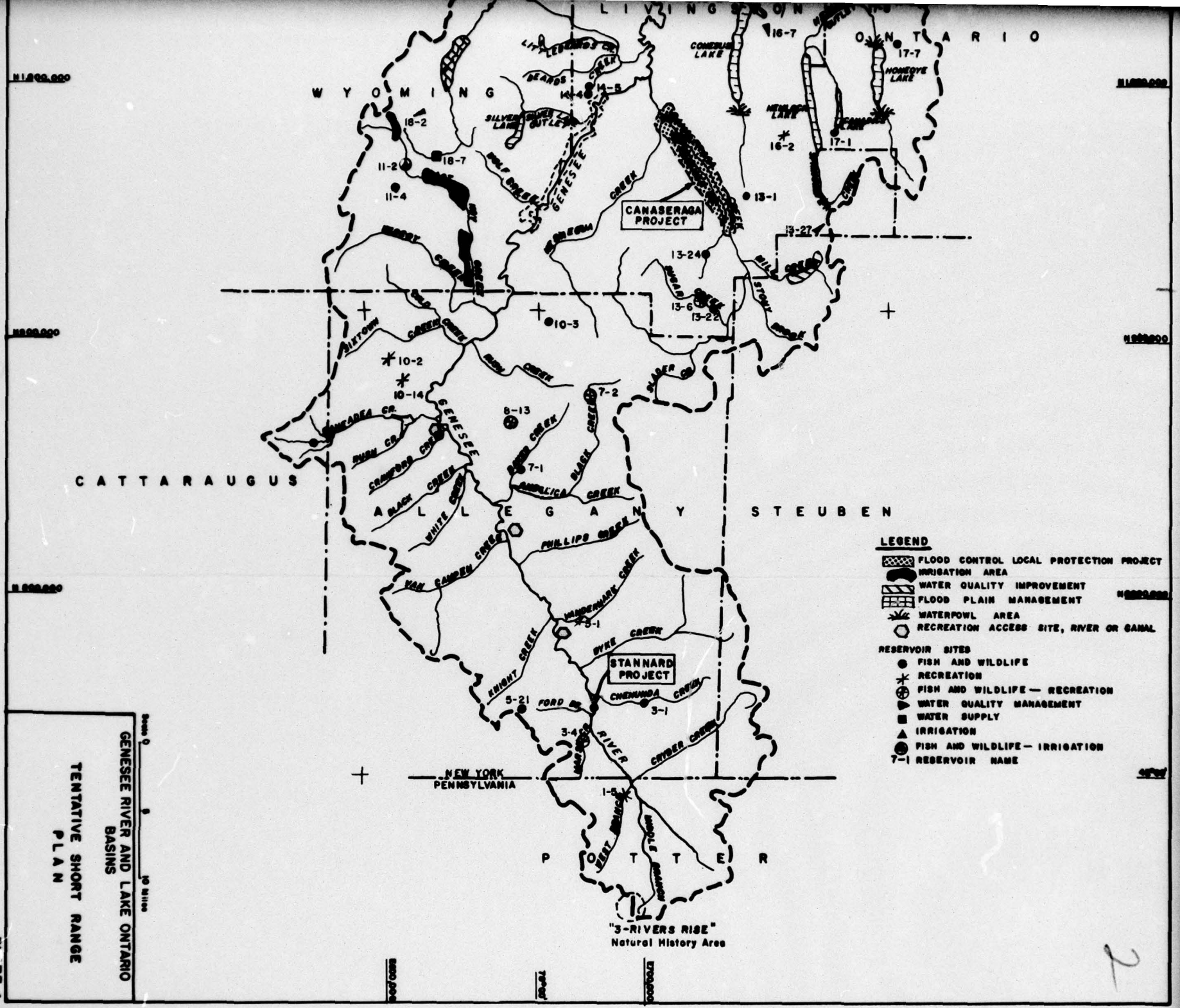
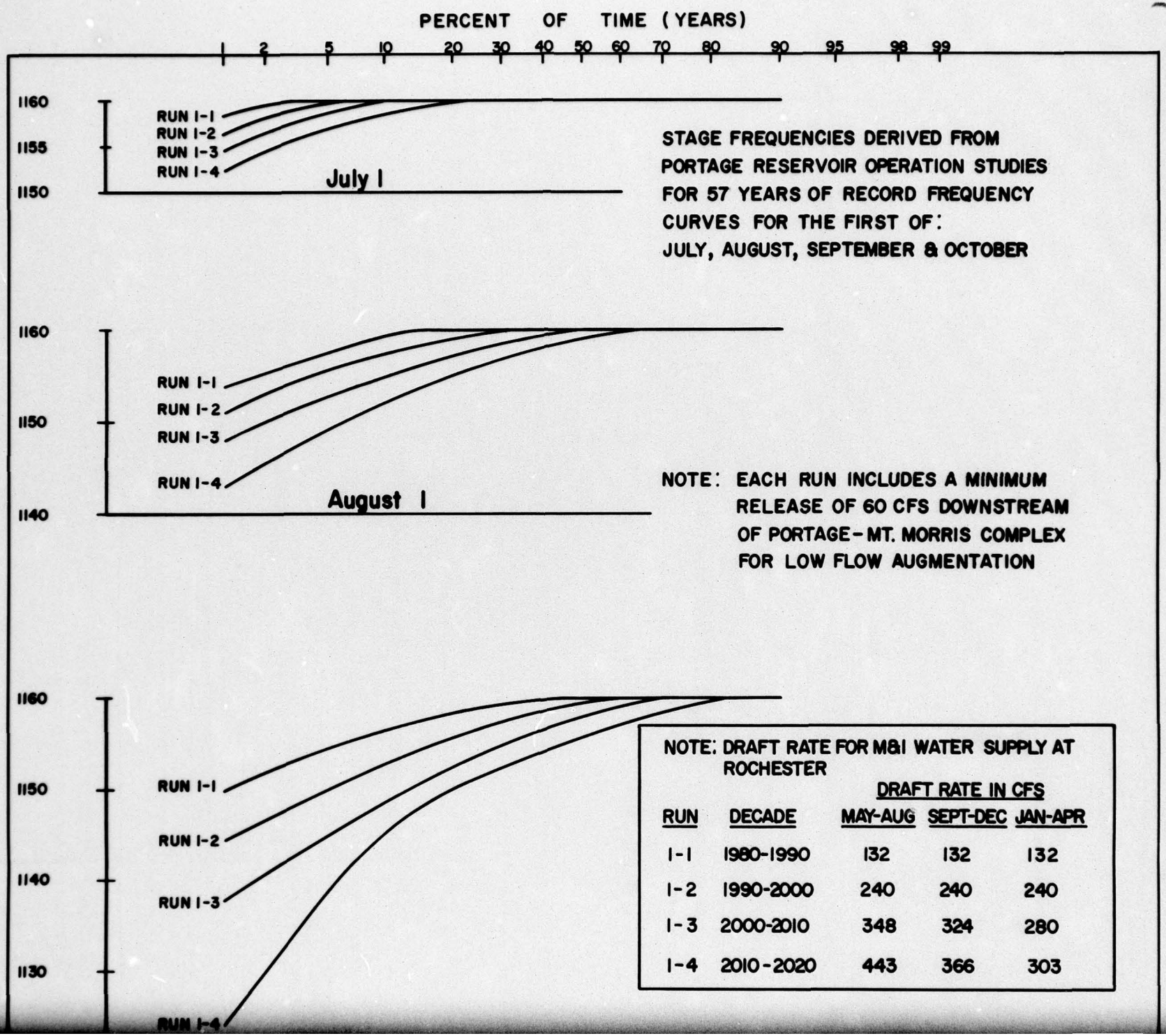
16-7
15-2
14-4
14-5
18-2
18-7
11-2
11-4
16-2
17-1
13-1
13-27
13-24


LIVINGSTON
ONTARIO
WYOMING
CATTARAUGUS
ALLEGANY
STEUBEN
PORTER
NEW YORK
PENNSYLVANIA
CANASERAGA PROJECT
STANNARD PROJECT
"3-RIVERS RISE"
Natural History Area
GENESEE RIVER AND LAKE ONTARIO BASINS
TENTATIVE SHORT RANGE PLAN
PLATE 4
LEGEND
FLOOD CONTROL LOCAL PROTECTION PROJECT
IRRIGATION AREA
WATER QUALITY IMPROVEMENT
FLOOD PLAIN MANAGEMENT
WATERFOWL AREA
RECREATION ACCESS SITE, RIVER OR CANAL
RESERVOIR SITES
FISH AND WILDLIFE
RECREATION
FISH AND WILDLIFE — RECREATION
WATER QUALITY MANAGEMENT
WATER SUPPLY
IRRIGATION
FISH AND WILDLIFE — IRRIGATION
7-1 RESERVOIR NAME

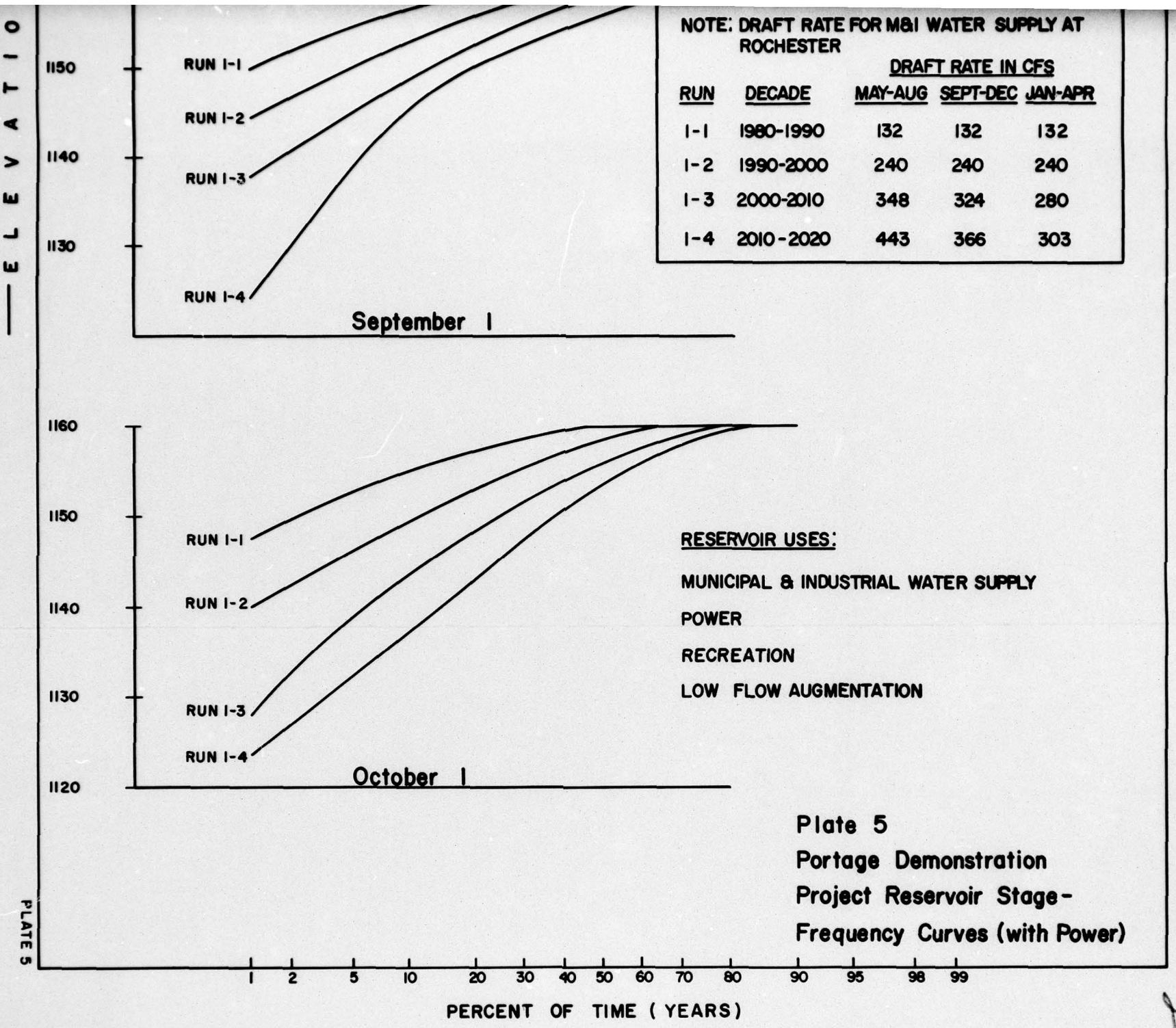


STAGE FREQUENCIES DERIVED FROM PORTAGE RESERVOIR OPERATION STUDIES FOR 57 YEARS OF RECORD FREQUENCY CURVES FOR THE FIRST OF: JULY, AUGUST, SEPTEMBER & OCTOBER

NOTE: EACH RUN INCLUDES A MINIMUM RELEASE OF 60 CFS DOWNSTREAM OF PORTAGE-MT. MORRIS COMPLEX FOR LOW FLOW AUGMENTATION

NOTE: DRAFT RATE FOR M&I WATER SUPPLY AT ROCHESTER

RUN	DECADE	DRAFT RATE IN CFS MAY-AUG	SEPT-DEC	JAN-APR
1-1	1980-1990	132	132	132
1-2	1990-2000	240	240	240
1-3	2000-2010	348	324	280
1-4	2010-2020	443	366	303



NOTE: DRAFT RATE FOR M&I WATER SUPPLY AT ROCHESTER

RUN	DECADE	DRAFT RATE IN CFS MAY-AUG	SEPT-DEC	JAN-APR
1-1	1980-1990	132	132	132
1-2	1990-2000	240	240	240
1-3	2000-2010	348	324	280
1-4	2010-2020	443	366	303

RESERVOIR USES:

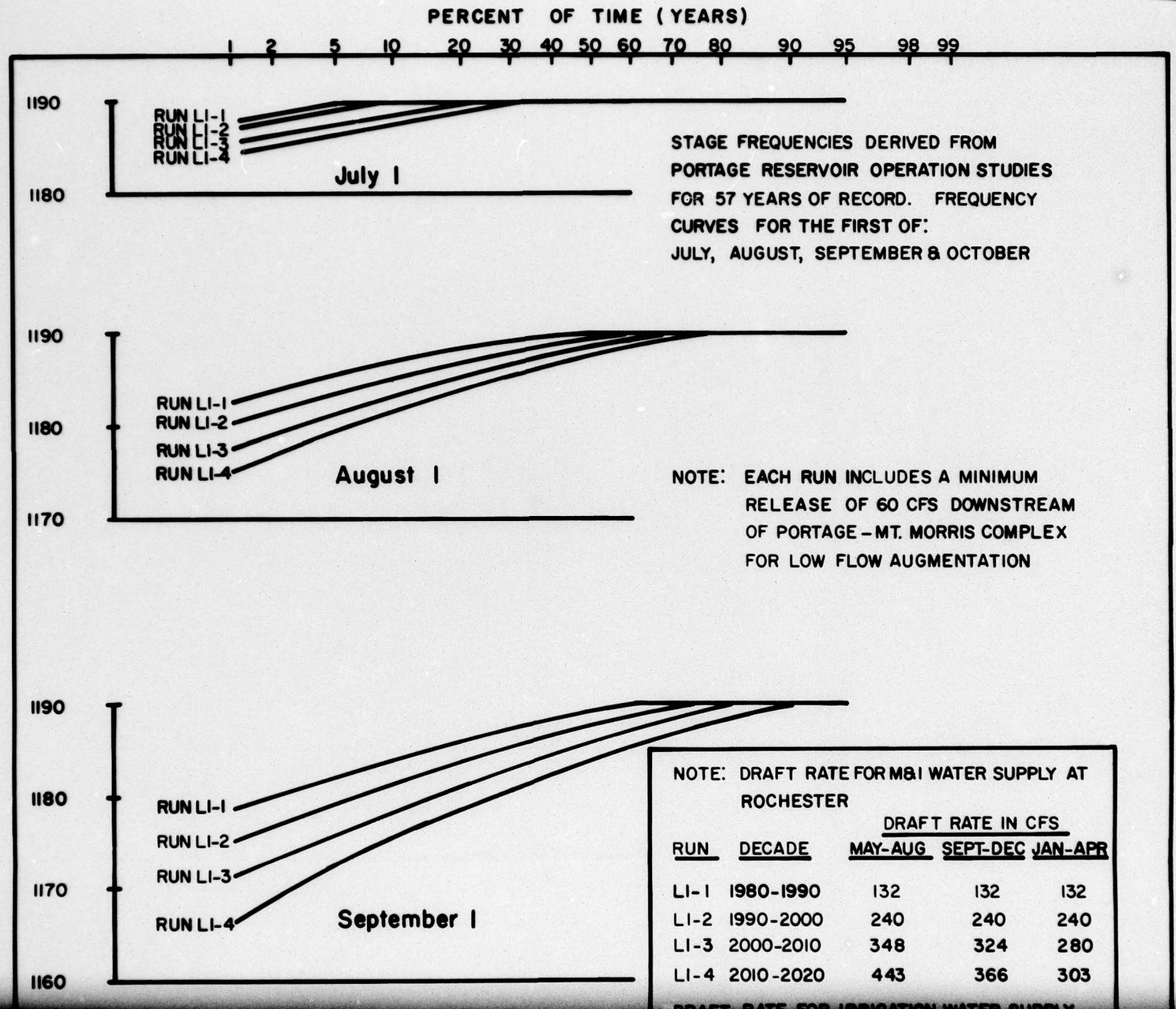
MUNICIPAL & INDUSTRIAL WATER SUPPLY

POWER

RECREATION

LOW FLOW AUGMENTATION

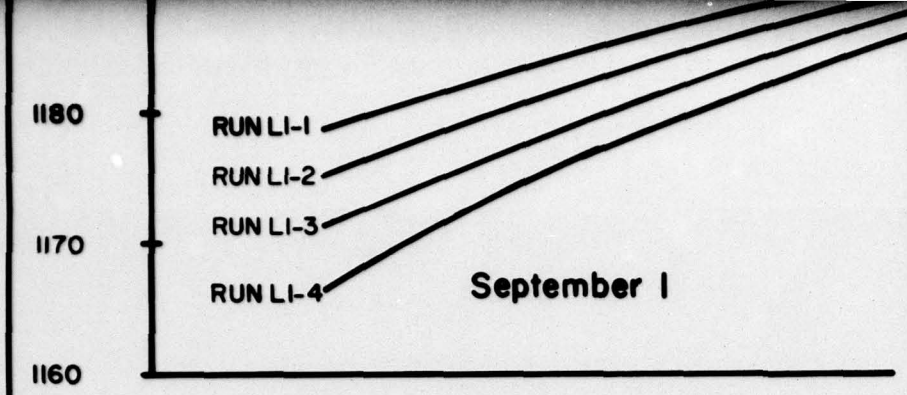
Plate 5
Portage Demonstration
Project Reservoir Stage-
Frequency Curves (with Power)



NOTE: DRAFT RATE FOR M&I WATER SUPPLY AT ROCHESTER

RUN	DECADE	DRAFT RATE IN CFS MAY-AUG	SEPT-DEC	JAN-APR
LI-1	1980-1990	132	132	132
LI-2	1990-2000	240	240	240
LI-3	2000-2010	348	324	280
LI-4	2010-2020	443	366	303

DRAFT RATE FOR IRRIGATION WATER SUPPLY

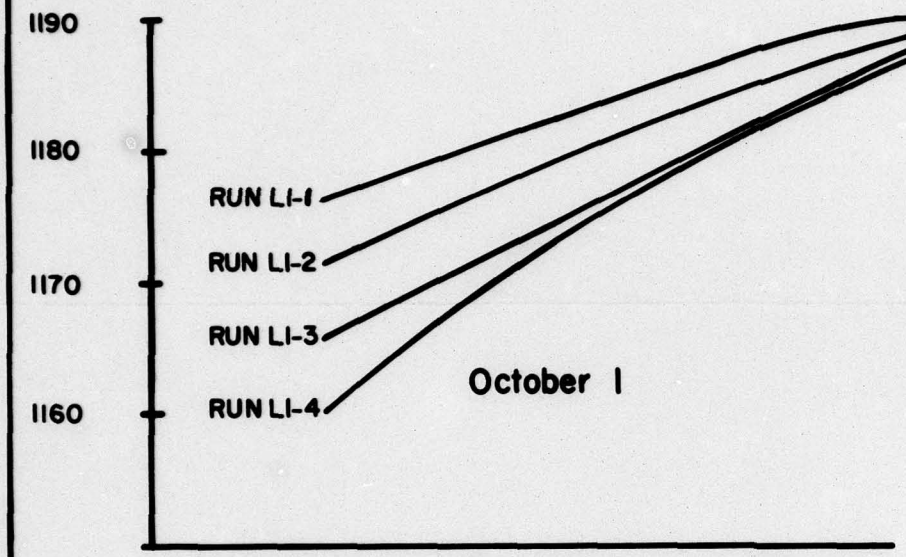


NOTE: DRAFT RATE FOR M&I WATER SUPPLY AT ROCHESTER

RUN	DECADE	DRAFT RATE IN CFS MAY-AUG	SEPT-DEC	JAN-APR
LI-1	1980-1990	132	132	132
LI-2	1990-2000	240	240	240
LI-3	2000-2010	348	324	280
LI-4	2010-2020	443	366	303

DRAFT RATE FOR IRRIGATION WATER SUPPLY FOR 24,000 ACRES IN CFS

JUNE -97 JULY-187 AUG-98 SEPT-17



RESERVOIR USES:

MUNICIPAL & INDUSTRIAL WATER SUPPLY
RECREATION
LOW FLOW AUGMENTATION
IRRIGATION FOR 24,000 ACRES

— ELEVATION (FE

PLATE 6

1 2 5 10 20 30 40 50 60 70 80 90 95 98 99

PERCENT OF TIME (YEARS)

Plate 6
Portage Demonstration
Project Reservoir Stage-Frequency Curves (Without Power)